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IRON TENDER FRAME.

The engraving on this page is a copy of a drawing of an iron tender frame designed and patented by Mr. B. W. Healey, Superintendent of the Rhode Island Locomotive Works.

The frame is formed of channel iron *C, C*, which is shown in section at *A, A*, and is braced laterally by braces shown in the inverted plan. All the braces and castings are riveted to the channel iron.

Mr. Healey writes us that a frame of this kind will weigh about 1,000 lbs. less than an ordinary wooden frame of the same size, and he claims that they are not

Contributions.

SIMPLE RULES FOR LOCOMOTIVE ENGINEERS AND MACHINISTS.

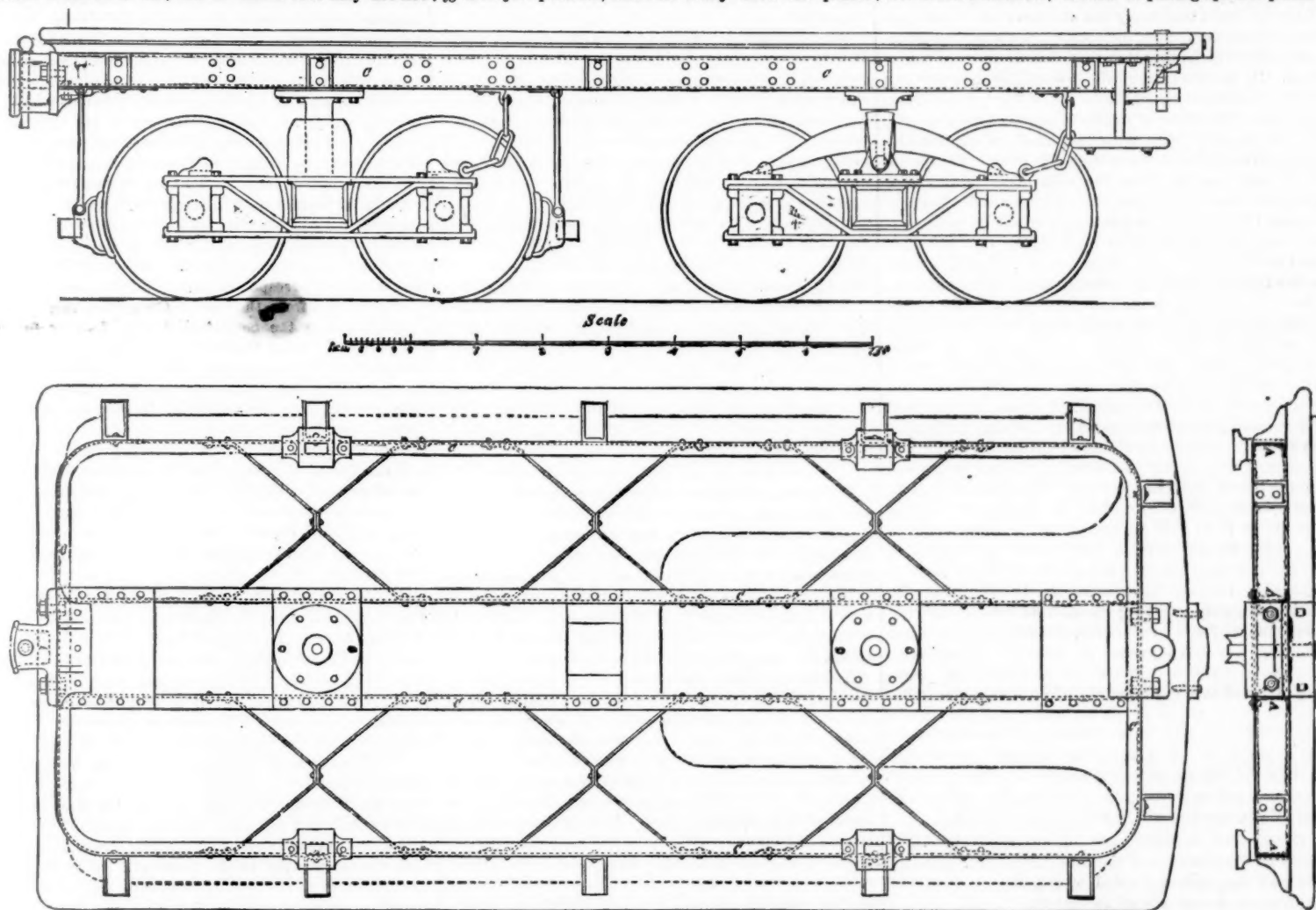
[Continued from Page 411.]

The services of men in the motive power departments of railroads have been too long regarded as mere labor. The men themselves have been partly responsible for the scale of estimation in which they have been held. They have seldom sought to elevate themselves to their just position, and not really until the public

cape notice? Look at the annual report of any railroad company. What are the heaviest items of expenditure? FUEL and REPAIRS OF ROAD. Next to these, by far the heaviest item is for REPAIRS OF ENGINES. These three items alone form nearly one-half of the vast expenditure necessary to work the road.

Now, it is very evident that all of these expenditures for repairs and fuel are directly within the influence of engineers.

The public begin to look upon it as undeniable that the occupation of a locomotive engineer is a profession, useful and honorable, and one requiring special qualifi-



INVERTED PLAN.

IRON TENDER FRAME BY THE RHODE ISLAND LOCOMOTIVE WORKS.

only lighter but more durable than frames constructed in the ordinary manner, either of wood or iron, but cost less.

"They have been tested in a number of collisions, and have, in all cases, not only sustained little or no damage themselves, but have saved the tank from injury.

"Some of the New England roads are replacing their wooden tender frames with iron as fast as they need renewal. Two hundred and fifty of them are now in use."

The frame certainly has a much lighter appearance, and, if the weight, cost and durability are as reported, it is another step in the direction of true improvement. Step by step iron is displacing wood, and if an iron tender frame is a good thing, why should not car frames be made of the same material?

A patent was granted to Mr. Healey for the adaptation of channel iron to tender frames on June 7, 1870. Any further information in regard to it can be procured by addressing him at Providence, R. I.

have seen clearly how heavy, and how arduous are the responsibilities of these men, has any general notion prevailed seeking to accord them just respect and consideration. There have been superintendents and directors of railroads, even, whose highest comprehension of an engineer's duties recognized only those of moving the "throttle" and reversing his engine. Under such a conviction, men have often been engaged in posts of the greatest responsibility, simply from considerations of economy, an engineer who would work for \$50 a month being preferred to one demanding \$65.

There never has been a time when so much attention was turned towards locomotive engineers and machinists as at the present. Stockholders are looking after the administration of the coal and wood pile, the machine shop, and the storehouse; they are looking into the economy of different rates of speed, of different systems of guarding against collisions, run-offs, and break-downs; everything is now under critical examination. Is it strange if, in such an overhauling, the services and qualifications of engineers should not es-

cations. In addition to temperance and good conduct, it is clear that an engineer should have some knowledge of the principles of his engine, some knowledge of its construction, of its proper capacity, and its just standard of consumption of fuel, oil, etc.; something that would enable him to determine, upon correct principles, whether his engine was doing as much as or more than its proper duty, whether he was using as much as or more than a fair standard of fuel, whether any improvement existed or could be made in his own over other engines, and some knowledge, indeed, that would assist him in judging of the precise influence and value of each proportion and arrangement of his engine. Why should not an engineer know all this? He, even more than the public, would be benefited by such knowledge. Let us see how:

He would immediately promote the economy and safety of the road on which he is employed. His services would consequently become more valuable, and he would also be treated with more respect. Whoever among the number of engineers should be considered

most intelligent would gain soonest the more profitable post of Master of Machinery. Respectability, trust, profit and general material good would as certainly follow such superior intelligence as motion would follow the action of steam in the locomotive.

Engineers do not consider how simple and how moderate are the professional qualifications required to fill posts paying from \$1,200 to \$3,000 yearly. They look upon the skill of a competent designer of machinery as they would upon that of a great master of musical art, as something to be admired and desired, but much beyond ordinary attainment. Without wishing to raise any extravagant notions upon these subjects, we may yet say that much more quackery than is supposed often prevails among men whose positions imply the possession of more natural gifts. It is enough, however, to say, that nothing in the mechanical engineering profession is beyond the attainment of intelligent operative engineers.

The object of these articles is to deal out, in an elementary manner, the successive principles and means of estimation with which engineers and others must become acquainted, in making the advancement so much desired.

We have already talked of the areas of circles. The rule was simple, and we mentioned a few of the thousands of applications of which it is susceptible. We have no doubt that every one who has read the rule perceived that the areas of different circles were in a different ratio to each other than that of their different diameters. By the use of the rule it would be seen that one circle, having twice the diameter of another, has four times the area. The areas of circles increase as their squares, that is, in proportion with the numbers obtained by multiplying the diameters, each by itself. Thus a 10-inch circle has 100 times the area of a 1-inch circle, just the same as a square 10 inches on a side, has 100 square inches, whereas another, one inch on a side, has but one square inch. Two engines, the one having 9 and the other 18 inches diameter of cylinders, would, other things being in proportion, have the same relative power as 1 to 4, not as 1 to 2. This seems plain enough, yet we once heard of a master of a machine shop having said before a court of justice, that one steam cylinder, having twice the diameter of another, had twice the area, and consequently twice the power. Let us take the rule for obtaining the circumference of a circle. It is quite as simple as that for obtaining the area of a circle, and perhaps a little better understood. "What is the use of the rule?" does any engineer ask, who never took the trouble to learn, or, if so, to remember it? One use of it is in the calculation of heating surfaces. Knowing the circumference of a tube, multiplying it by the length, gives the superficial extent, or area of surface. Another application is in obtaining the distance around a driving wheel, from which, knowing the number of turns per minute, we may know the speed at which any driving wheel is running. Or, by dividing a mile, which is 5,280 feet, we may know the number of turns required to be made in running one mile. So, too, the length of sheets for making, or for covering, a boiler may be found. Knowing the circumference of a boiler, or of a tube, its weight may be also estimated. These, and many others, are applications of the rule; and by keeping them in view, as well as seeking others, the rule will be always remembered.

RULE.—The circumference of any circle is 3.1416 times its diameter; or if the diameter be multiplied by 355, and the product divided by 113, the quotient will express the diameter very accurately.

Example.—What is the circumference of a 5-foot driving wheel? Five feet reduced to inches is 60 inches. Multiply 60 by 355 and we have 21,300. Divide this by 113, and we have 188½ inches (nearly) as the measure of the circumference.

$$\frac{355}{113} \times 60 = 188\frac{1}{2} \text{ inches, nearly.}$$

The answer is thus 15 feet, 8½ inches, nearly. This would require 336 turns in running one mile.

What is the weight of a 48-inch boiler shell, 10½ feet long, and 5-16 inch thick? making no allowance for laps and rivets.

Weight of Boiler Iron.		
¼ inch iron,	10 lbs. per square foot.	
5-16 " "	13½ " "	
¾ " "	15 " "	
7-16 " "	17½ " "	
½ " "	20 " "	

By the first rule given,

$$\frac{3.1416 \text{ multiplier.}}{48 \text{ inches diameter.}}$$

$$150.7968 \text{ inches circumference.}$$

This may be called 150 4-5 inches, which, multiplied by 126, the number of inches in 10½ feet, gives 18,950 square inches in the surface of the boiler. This, divided by 144, the number of square inches in one square foot,

gives 131 6-10 square feet. This number of square feet, multiplied by 12½ pounds, (weight of 5-16 iron per square foot) gives the whole weight as 1,645 lbs. F.

RELATION OF TRAINS TO CURVES.

BY S. J. WALLACE.

[Continued from Page 468.]

Composition of Forces—Analysis.

The composition of forces in a moving train has never been analyzed. Astronomers know what particular forces affect each planet, and the nature of their powers and variations. They know the action of the planet in space will be the exact resultant of these combined forces, and that the problem of movement in a body is simply one of amounts and directions of force and resistances, in mass.

If planets required engineers, as railway trains do, to provide structures to withstand the strains to which they are subjected, astronomers have the requisite elements to determine the framings needed, in knowing exactly what are the forces, their confluences, and maxima. But railway engineers do not know what are the particular forces and resultants they must provide for. They guess at some obvious ones, and follow the rule of increasing a part when it gives out. But they cannot from known data strike directly the simple requisites.

Why cannot the railway train have its astronomy? If the railway world would organize its interest for the purpose, it could establish a corps of the highest abstract science as a regular institution to work out the forces of moving trains and construct a railway science. For great millions of cost are swallowed up in motive power and repairs on account of the broad, uncertain margin between too much and too little, against which knowledge does not exist.

If railways wish the work done thoroughly, they should pay heavily for it, as is due, and make heavily by doing so. It is no transient job, either; long years will still continue to bring out important new results.

Maximum strains and extreme resultants are the elements the engineer seeks, because in providing for them all the intermediate ground is usually covered, and without them disaster and loss must occur. But to reach these intelligently, the several forces of which they are composed require to be separated and their usualities determined, as a basis for reaching their exact laws and effective results.

Analysis of Leading Forces in Trains.

The principal kinds of forces in moving trains which act as elements of strains may be stated as gravity, draft, momentum, primary and secondary resistances. The three first may be regarded as positive forces, or active strains which flow together and produce direct confluent resultants. The other two are negative forces, no less real, but passive in their nature, which unite with the positive forces by opposition to modify their action and form new co-resultants of strain.

I. Gravity.—This element has its direction directly downward from every part of the mass, with a center of action in the effective center of each inflexible mass. It affects each car or mass separately, and in exact proportion to its mass weight with load. In running, its strain is varied to various equal extents above and below the regular amount at different instants of time, by oscillations. This extravagantly increases its maxima. The extent of this variation depends upon the controlling features of total weight, speed, evenness of wheels and track under action, and on the capacity of car-frames to maintain uniform gliding motion against the bouncing of elasticity on one side and the shocks of inelasticity on the other; and it is modified in practice by the use of springs.

In a moving train the force of gravity is confluent with the other active forces in each car, producing various resultant strains in different virtual directions. All of these strains in their variations must be provided for separately by at least three parts in each car—the car frames, the wheels and wheel connections, and the track.

II. Draft.—This element has its direction along the track in the course of the train. It affects the train as a whole, and does so in a peculiar way. It varies in full amount with the exertion of the engine. Its highest point of strain is at the engine, and it decreases backward through the train in exact proportion to the effective resistance in each part. It may be more or less in amount than the force used up in running at the time of the exertion. And, in passing through the train, it is composed always of one and sometimes of two distinct portions.

1st. The force of the engine which passes directly to be used up in the resistance of running, at the time. This is the whole draft, except when the speed of run-

ning is increasing, when an excess passes directly into momentum. This portion of draft is mainly applied by the wheels at the points of their contact with the rails, and has its true line of strain within a ribbon-like plane along the surface of the rails, which has its edges bounded by straight lines connecting the points of contact of the wheels along the sides.

2d. The force of the engine which passes directly into the increase of momentum in greater speed. This only occurs when the exertion of the engine is more than is used up in running, and is the excess. It is distributed throughout the train in exact proportion to the mass weight of the parts, and constitutes a store of force liable at any instant to pass into the expenditure of running to supply deficiency of the engine, in a graduated manner. This portion of draft, when present, has its true line of strain within a space directly upward from the ribbon plane of the other portion of draft, and passing directly from the plane of contact of driving wheels on the rails to the virtual center of the mass of resistance of weight, as represented by each car in its turn.

Both these portions of draft, though separate in effect, unite in the transmission in a true line of confluent strain the resultant of their amounts and directions. This varies in height from the level of the track upward as the comparative amount and height of strain passing into momentum, at each instant of time. When the line of couplings between the cars is higher than this line of strain (as it always is), the strain then draws downward on the couplings with a force proportionate to the total amount of strain and of angle made in the line of strain by the elevation above its true line. This downward force on the couplings thus varies directly with the height of the couplings, and draws down the ends of the cars, tending to bend them upward in the middle or to lift their opposite ends. It is greatest at the locomotive, because the force of draft is greatest there, and because the true line of draft at that point never rises above the surface of the rails, and it tends correspondingly to lift the front end of the locomotive from the track. On curves this is unfortunate, from the confluence there of other forces which tend to carry the front end of the locomotive over the outside rail of the curve, and against which the controlling force is the great weight holding it down on the track. The downward strain on the couplings decreases backward in the train as the draft, and tends to hold the whole train down except the ends.

If the line of couplings could be sunk below the true line of strain, it would tend to lift the couplings and hold the extreme ends of train to the track, as is especially needed on curves. Or, if it were done even with the locomotive and trailing car the conservative effect would be secured.

On curves the strain of draft gives rise to another secondary force, from the bending of the line of draft sideways from a true straight line. This force has a direction at right angles to the track and towards the inside of the curve. It varies at each point in the train as the draft decreases, and it is proportionate to the amount of curvature. It tends to draw the wheel flanges against the inner rail throughout the train, except at the extreme ends, which it throws, by counter action, against the outer rail. Thus, on curves, it is a force which tends to counteract the tendency of the momentum to act as a force against the outer rail, except at the extreme ends of the train, where it unites with the momentum in its disastrous effort to pass over the outer rail. The seriousness of this at the locomotive arises from the fact that the force is at each point in direct proportion to the draft, decreasing backward, so that its full force is exerted to throw the locomotive from the track, uniting with the greater force of momentum in the heavy locomotive. It may be a question if some arrangement could not be devised of running suitable low cars before the locomotive to relieve it from the accumulation of dangerous forces which unite in the ends of the train, as well as to protect from collisions, etc.

The portion of the draft which is directly used up in the running, as it is exerted by the engine, is composed of one part on straight lines, and on curves, of the same increased and an additional part.

First, that used up by running each portion as if separate. This increases on curves, because the rigidity of the wheel arrangement makes the wheel flanges bind and rub against the sides of the rails, and because the wheels must slip on the rails enough to equalize the two sides of the curved track. This part of the draft is liable to many disturbing influences, dependent on the line of track and on the structures used in the train and track; but it may be regarded as approximately uniform in tendency in every part of the train.

Second. The draft force which is used up in running

as the result of transmitting the draft through the train. The strain through the train adds to the rigidity and inflexibility of train to various irregularities met, as between the wheels and track, so that it may be said, even on straight lines, to cost motive power in ratio with the want of perfection of track, wheels and cars. But it is on curves that the transmission of draft strain becomes important by tending to draw the wheel flanges against the inner rail and thus lose force. As the force of draft decreases backward through the train, the cost of transmission might be expected to likewise decrease regularly. This is in fact the tendency, but greatly varied by the effect of the counter force of momentum which is exerted on the outside rail of curves, so that the loss from passing the draft at each point exists only to the extent by its excess of strain across the train at that point over the counter tendency of momentum, while the loss from the action of momentum itself is reduced to the amount of such mutual counter action. Thus there may be no loss from momentum acting against the sides of the rails in the front part of the train, and none from draft in the back part; both are very variable, excepting at the ends of the train, where both unite for loss and danger.

III. Momentum.—This force has its direction in a straight line in each car separately in the direct course it is moving, and has its true line of strain from the center of weight of each inflexible mass. It affects all portions of the train in a like way, and in exact ratio to their weights and to the speed. Its direction corresponds exactly with that of the draft on straight tracks, and differs from it on curves by the amount of curvature. On curves, in proportion to its force, it tends to throw the wheel flange against the outer rail, while the force of draft, except at the ends of the train where they act together, acts toward the outer side of the track. The nature of this relation is such that momentum may throw the back portion of the train against the outer rail, while the draft may draw the forward portion against the inner, except at the ends of the train. (The statement on this subject in a former article was merely approximate.)

The forces of gravity, momentum and draft unite to produce a confluent resultant on a line of direction intermediate to themselves in proportion to their powers. This line falls within the space between the rails. If a curve were sharp enough, and either the momentum or the draft were increased so as to throw the confluent line of force outside of the space between the rails, then the train would fly from the track—say from the trailing car as far forward as the condition extended. On curves, the outer rail is raised to reach beyond such range of variation and to throw the center of all the forces further from it, to secure safety.

The treads of car wheels have been made conical to assist in passing curves. They would just suit the purpose, under an impossible set of conditions; that is, first, if the road was composed entirely of curves, without straight parts or large curves; second, if the train always ran on such road by the force of momentum or gravity (as on down grades), without draft to draw toward the inside of curve; and third, if, then, each pair of wheels was separately free to adjust itself, endwise of axle, to the track, and radially to the curve. If any part of these conditions fail, conical wheels cannot possibly serve their purpose. On straight lines or large curves conical wheels cause rocking and straining from side to side, by alternate action of the cones on either side, liable to injure the car frames, the wheel arrangements, the rails and track, and the road-bed, and is disagreeable to passengers or freight, besides using up costly motive power. On sharper curves all this is aggravated, by incapability of adaptation to track, and by the draft drawing to the inner rail. Close competition must soon remove the feature from use. It would be admissible to use a pair of conical wheels at each end of a train, on very crooked roads, with little straight track, because at the ends of a train wheels always follow the outside rail; no others do.

The force of momentum passes into use in the running of the train in a definite way—just to the extent requisite to maintain a gradually decreasing speed, exactly in correspondence with the amount of momentum remaining at each instant, in proportion to the weight of the train.

IV. Primary Resistance.—This element consists of the forces which are not active, and which unite with the active forces in reaction from resistants, to give them changes of direction, so as to be further useful, or be lost.

1st. Resistance of Inertia. Where force passes into momentum. It has directions forward and useful, or lateral and injurious.

2d. Resistance of track, with three kinds of direction: first, longitudinal with the track, as a strain transmitted

back from the driving wheels and against the car wheels; second, vertical, to resist the strains of gravity; and third, lateral, or across the track, as against the flanges. It is a question whether the lateral strains should not better be provided for by distinct wheels, thus better suiting each device directly for a simple strain and relieving the present barbarous arrangement of wheels.

V. Secondary Resistances and Forces they Absorb.—This element includes all those active and negative forces acting in or through the train as the result of the four principal forces. It is the ultimate of all the motive power used. Its consistence and amount depends upon the perfection of the structures and arrangements used. Its composition is too complex for present analysis. It is very serious in its cost of motive power, and in the confluence of its larger forces with others in the train affecting their practical resultants to render them uncertain or mischievous.

This separation of kinds of forces and their usualties in the moving train, though not complete, may enable their separate study, and lead to intelligent results. The subject certainly deserves a full discussion.

KEOKUK, IOWA.

CAR CONDUCT—CLASS CARS—LADIES' CARS, ETC.

The social status in the old world is a matter of birth, caste and calling, to a great extent; but here we profess to know nothing about an aristocracy, a middle or lower class, and simple human rights are all the rights any of us can assert or maintain.

Hence, any attempts at arbitrary social distinctions are received with disfavor, and only disturb our equanimity, without attaining any good end. And we may well point to the results of various schemes of railroad managers to regulate social pretensions, in illustration of our theory: they have all turned out utter failures,—as they certainly should.

Nothing so touches our pride or arouses resentment as to be told, even indirectly, that we have somewhere a superior, and that we must accept the situation and behave ourselves accordingly. But to be given the inferior position when we have paid for the best is an outrage beyond all bounds of endurance; and no wonder that commotions, disorder, and ill-blood ensue, wherever the thing is undertaken with the rail-riding public.

It won't do at all—and the sooner abandoned the better.

Our plan, as suggested in a previous article, obviates all these difficulties naturally, and in a way to offend no one. Giving preference or precedence to none and adopting regulations for the good of ALL—which all must observe and obey—is alike democratic and just; a rule that would very soon—like gravitation and other natural laws—come to be observed; because to disregard it involves evils endless, and for which it would be hard indeed to suggest a remedy.

Yet, the "ladies car," was a result of great gallantry, and the best of intentions, on the part of railroad managers, doubtless. They saw the inconveniences and embarrassments under which ladies sometimes traveled, and wished to afford them relief as far as possible. But like the parish which essayed to remove its meeting-house from the neighborhood of a dead dog, the railroad put the ladies in a car by themselves (live statuettes under glass), but did little to avoid the offenses, which created the necessity for such seclusion. It would have been better for the church to have removed the dog, and for rail-men to abate what they only tried to avoid. If above ground, both would continue an annoyance—to somebody.

Worthy and sensible ladies undoubtedly appreciated these intentions duly, and were thankful therefor. But, really, they had something to regret as well as to prize, in the attention referred to; and sometimes felt that they lost more than they gained thereby. Intelligent women are social as well as sensitive, and would occasionally endure a boor rather than be denied the society and conversation of polite and well informed gentlemen. To be debarred such privilege, compelled the companionship of the weak and frivolous of their own sex during a long journey, is surely an affliction for which they would thank no one, however sugared over with "good intentions."

Real ladies would prefer perfect freedom in this affair, with enforced regulations applicable to all alike; while, if the McShoddy and McFlimseys demanded a special car, and could get it, nobody would object.

But the classification as now attempted on some roads defeats itself and renders ladies more liable to annoyance and insult than they would be in a promiscuous crowd. These select cars being under the control of a conductor, he can admit whomsoever he

will to their sacred precincts; and his boon companion of the ladies' room, billiard hall, or other resort, has free access thereto, while the worthy and intelligent are as often excluded. Ladies may thus become victims of a regulation, ostensibly adopted for their special good and protection. But this "sheep and goat" arrangement presents its worst phase where the goats do mostly congregate—in the so-called "gentlemen's" car.

First, vulgarity and profanity are there unrebuked; and if a very repulsive female has a ticket, the authoritative brakeman has no hesitation about shoving her in with "us men"—although he deems her unfit for a place in the first-class car, devoted to ladies exclusively; and he quite as remorselessly gives Rev. Mr. Sack-cloth the same direction, because alone; while a faro-banker and his picked-up nymph, who are both avoiding the police by a temporary absence, are duly installed amid the glare and upholstery of palace car accommodations!

D. D.'s and drunken women herded in the one car, and ladies consigned to the companionship of black-legs and bawds, because they might be contaminated by associating with a more promiscuous crowd! But these are unavoidable incidents of such an arrangement; and unless we can be rid of the one, we must endure the other as best we can.

But evils beget their kind, and the brood is multiplied. Enduring the first insult, we soon have plenty of others to consider and tolerate, if we will.

Some Western companies have already refined upon the original plan and run two cars only—the "ladies" and the "loafers." On the first, scarcely the shadow of propriety due in all places is retained, while in the other, no sort of beastliness revolts, or is objected to by any in authority. You buy a "first-class" ticket, but, if without calico-protection, are shoved by an insolent employe in where the stove may be used for sausage frying or diaper drying; the atmosphere is black with tobacco fumes, and the floor slippery by the saliva of a score or two of poison victims, and who must spit perpetually or split. And one finds the last feather of endurance when he sees this special car disgorging its male bipeds, who are hastening into the front receptacle, the "gentlemen's car," to enjoy their pipe or penny-grabs where they can unmolested. It is not polite to smoke into ladies' faces, and so they leave their dears for the nonce and go where their victims are unprotected, however much they may object. Of course, well-managed first-class roads would not permit a practice so reprehensible, and probably but one company having a terminus in Chicago, has yet tried the experiment; but any one riding far South or West will find numerous and aggravating samples of the evil referred to, and become an honest and zealous convert to the reforms we have suggested hitherto. Abandon class cars entirely and enforce rules and regulations looking to the right, comfort and safety of all passengers alike, and the thing will be done—and railroad managers entitled to distinction as social and civil reformers, in addition to their great merit as perfectors of the round world we are given to possess and improve for the time being.

IRON POINT.

THE COMPOUND STEAM ENGINE.

At the last meeting of the New York Society of Practical Engineering, Mr. Charles E. Emery, Consulting Engineer, who had been requested to read a paper on the above subject, said that, being pressed for time, he had not been able to prepare an elaborate article on the subject, as he had intended, and therefore read instead a letter he had recently written to Capt. C. P. Patterson, Hydrographic Inspector, United States Coast Survey, for whom he was now designing some engines of the plan referred to. We give his letter in full:

FEBRUARY 29, 1871.

Capt. C. P. Patterson, Hydrographic Inspector U. S. Coast Survey, Washington, D. C.

DEAR SIR: In reply to yours of February 24th, requesting "a brief statement of my views in regard to the advantages of the compound over the single engine, and the causes of the advantages, particularly for propellers," I will state that I consider that the compound engine may be applied with advantage in any location where economy of fuel is desired. I give two points of superiority, with explanations and discussions as brief as the subject will admit:

ADVANTAGES OF THE COMPOUND STEAM ENGINE AS COMPARED WITH THE ORDINARY DOUBLE-ACTING ENGINE.

1. It furnishes a better working engine, mechanically, for utilizing the benefit of the expansion of high pressure steam.

This point will be very generally conceded. The expansion of steam is necessary to secure economy; but, if the application of the principle be carried to the ex-

tent desired, the great changes of pressure in the cylinder cause severe strains on the main connection, and although the latter be made unusually strong, it is frequently found expedient to reduce the pressure, and necessarily the measure of expansion, and so increase the consumption of fuel, in order to reduce the losses caused by frequent repairs, but more particularly by the delays they occasion. The compound engine, in any form, equalizes the strains and distributes the load.

2. Independently of mechanical considerations, it is more economical to use steam expansively in a compound engine than in any form of the ordinary engine.

This point must be accepted as a fact by any one who will examine the evidence available, but the abstract explanation of the result is impossible by any of the laws heretofore laid down in respect to the steam engine.

It should be borne in mind that, contrary to the opinions of many, there is no gain in power by the addition of the small high-pressure cylinder of the compound engine, for the effective pressure upon its piston is only the difference between that of the entering steam and that admitted to the second cylinder. There is, in fact, a little power lost in transferring the steam from one cylinder to the other. It is not strange, then, that nearly all American engines condemn the compound engine and declare, in spite of all failures, that the same result can be produced in a single engine if it be made of sufficient strength to withstand the unequal stream. These engineers simply judge from the information they have had the opportunity of acquiring. They have been taught that the capacity of the cylinder is the measure of the steam used, and reason that if the compound engine gives no more power with the same steam, it is a useless contrivance. No other conclusion could be based on such an assumption. The error in the reasoning lies in the fact that the volume of the cylinder is not an accurate measure of the quantity of steam used by the engine. This fact has been proved by experiment, both at home and abroad, but, strange to say, has never attracted much attention. People will assume that steam can be measured by the cylinder fully as accurately as peas in a bushel; but the fact is, that the metal walls of a steam cylinder are at every stroke so cooled by the performance of work, and by the low temperature during the exhaust, that the live steam, upon entering, has two offices to perform, viz: 1st, to reheat the surfaces, and 2d, to fill the cylinder and maintain the desired pressure. In many cases it may require as much steam to do the first as the last; and as the steam for the first purpose is condensed, that for the second will only fill the space; and, in fact, two volumes of steam may enter a vessel capable of holding but one of a liquid or non-condensable gas.

During the government expansion experiments, and others of a private character, I had ample opportunity to ascertain the accuracy of the above views, and found that the benefits to be derived from expansion were, in the manner stated, greatly reduced, though not entirely overcome, as had in some cases been claimed.

I believe these losses could be prevented, and, with means furnished by capitalists, have tried over 250 experiments to ascertain the value of the various devices for accomplishing this end. The nature of the loss was proved in the following manner: "I constructed two cylinders of like dimensions, one of glass, the other of iron, in such a manner that either could be attached to a valve which regularly admitted steam from a boiler to the cylinder and permitted its exhaust into a condensing coil lying in a tub of water." The capacity of the two cylinders was made exactly the same, as was shown by transferring water from one to the other. When put in turn in condition of a steam engine cylinder, the iron cylinder used (averaging the experiments) fully twice as much steam as the glass one, shown by the fact that twice the quantity of water came through the condensing coil for the same number of movements of the valve. Steam of the same pressure was used in both cylinders, and the experiments were many times repeated, with substantially the same results. This settles the question. The glass cylinder saved half the steam. The cylinder of a perfect engine should, then, be made of glass or other non-conducting material, which may be explained in the following manner: Tyndall has found that aqueous vapor is one of the most powerful radiators and absorbers of radiant heat known. Steam, when slightly chilled by the performance of work, is in respect to heat in the same condition as the aqueous vapor of the atmosphere; therefore, if steam enters a cylinder at, say a temperature of 280 degrees, and heats the metal surfaces to that point, when such steam is exhausted and falls in pressure so that the

temperature is only, say, 180 degrees, the surfaces rapidly radiate heat, which is absorbed by the steam and carried to waste; and the next steam that enters has to re-heat the surfaces, and an additional quantity is required to fill the cylinder and do the work. A non-conducting cylinder does not become cooled; it is not therefore necessary to reheat it, and only the exact quantity enters which is required to fill it.

I experimented considerably to make an engine with a cylinder of non-conducting material, and only desisted, temporarily, when it occurred to me, and I proved by experiment, that nearly the same result could be obtained by the use of a modification of the compound engine which involved no difficult mechanical details.

The transfer of heat from the metal walls of the cylinder to the exhausting steam takes place in two ways, viz.: by direct contact and by radiation. The bulk of the steam can only be acted upon by radiation, which therefore causes the material part of the loss.

It has been proved by experiment that the quantity of heat transferred from a radiating to an absorbing body varies as the square of the difference of temperature of the metal surfaces; so, taking the previous case, viz., that the temperature of the metal surfaces of a steam cylinder is 280 degrees, and that of the exhaust steam 180 degrees, the difference in temperature is 100 degrees; and, if we use the steam in two cylinders instead of one, we may reduce the temperature in each to, say, one-half that amount and the condensation will be as 1^2 to 2^2 , or one-fourth as much in the two cylinders as in the single one, or not less than one-third as much, if an allowance be made for the increased surface in the two.

This explanation shows that if the condensation in the single cylinder be one-half the whole amount, that $\frac{2}{3}$ of this, or $(\frac{2}{3} \times \frac{1}{2})$ one-third of the whole may be saved by the compound engine, which calculation agrees with the facts, but varies, of course, with the changes in the conditions.

The explanation once obtained, it enables one who has studied the subject to proportion the compound engine so as to obtain the maximum efficiency. I have known many of them that were so constructed that they gave but little better results than a single engine. In addition to the above, it is well to state that during the experiments several improvements applicable to the compound engine were worked out, which, in connection with the principle, using a steam pressure of only forty pounds, reduced the cost of power in the experimental engine from 39.2 lbs. of feed water per horsepower per hour to 23.6 lbs. This proportion of saving would, in a larger engine, reduce the cost to as nearly that promised in my theory as the most sanguine could expect, for large engines are positively known to be more economical than small ones, which may be explained by the fact that the ratio of internal surface to capacity decreases with the size of the cylinder.

Further details would make this communication too lengthy. I should be happy to furnish you with a more elaborate discussion of the subject if desired. The practical evidences of the advantages of the compound engine are overpowering, as nearly all the large ocean steamships recently constructed abroad have such engines. One of these vessels, 400 ft. long, according to the statement of a representative, crossed the Atlantic inside of twelve days, with a consumption of only forty tons of coal per day.

The Canada Southern Railway.

TO THE EDITOR OF THE RAILROAD GAZETTE:

It may be of interest to your readers to know something of this new line, which is attracting considerable attention both in the East and West. The Canada Southern Railway is intended as a link in a short line between Chicago and New York. Its eastern terminus is the International Bridge at Buffalo. From this point it passes in a most direct line through the peninsula of Ontario to Amherstburgh on the Detroit River, a distance of 228 miles. It is also proposed to build a branch from the main line at St. Thomas to the St. Clair, at Moore (opposite the village of St. Clair, in Michigan), a distance of 63 miles.

The connections at the eastern end are the New York Central Railroad, the Erie Railway, the Buffalo & Washington Railroad and the Oswego Midland Railroad, when completed; at Amherstburgh, on the western end, the Canada Southern & Chicago Railway, and the Lake Shore & Michigan Southern Railway; at St. Clair, on the western end of the St. Clair Branch, with the Michigan Midland Railroad, the Peninsula Railway and other lines projected northerly and westerly into Michigan. The Canada Southern Railway presents some new and peculiar features, among which are these: It

will have no grade exceeding 15 feet to the mile. It has over 125 miles of level grade. It has no curvature with radius less than 1,910 feet, and but ten miles of curvature in the entire line, composed as follows:

Curvature with radius of 11,460 feet.....	2 4-10 miles.
" " " " 5,730 ".....	4 1-10 "
" " " " 3,865 ".....	2 0-10 "
" " " " 1,910 ".....	0 9-10 "
Total curvature.....	10 00-10 "

It has two tangents or straight lines 52 miles each in length, one tangent 28 miles in length, one tangent 17 miles in length. These on the main line, while on the branch there is one tangent 45 miles in length.

At no point on the road will curvature and grade exist together presenting resistance greater than the maximum grade on tangents. No bridge on the road is on a curve and none that is not approached by a tangent over 1,000 feet in length at either end—an important point as regards the safe operation of this road.

Some few temporary structures are to be built at first, but as soon as the track is laid, permanent work will at once be put on. The permanent bridging need not exceed 1,300 lineal feet in length.

The company is organized under the laws of Ontario, and is composed of some of the most prominent and wealthy railroad men in the States, among whom are Milton Courtright, the President of the company; Daniel Drew and Sidney Dillon, of New York; John F. Tracy, of Chicago; W. L. Scott, of Erie, Penn., and others of the same class. The capital stock was all subscribed last spring. The surveys were commenced June 1, 1870, and the location completed January 1, 1871, with the foregoing results.

I deem it unnecessary to draw any comparisons or enter into any discussion as to the merits of this line. Your readers, who are mainly railroad men, will draw the natural conclusions as to the standing this line will take upon its completion, which will be early in the year 1872. It is the purpose of the directors to build and equip the road in first-class manner throughout. The track will be of the best Bessemer steel rails, weighing 60 pounds to the yard, with 2,500 cross ties to the mile, laid with chairs and fish-joint, and upon gravel ballast. The gauge is the American standard, viz: 4 feet 8½ inches. Grading was begun last October on all heavy work, and is progressing rapidly. The bridging is all under contract and the timbers mostly on the ground. As soon as the frost is out of the ground the entire work will be pushed to rapid completion. I shall, if agreeable to you and your readers, take pleasure in giving some further facts regarding comparative distances between objective points by this and the old lines, and also regarding the country through which the road passes.

F. N. FINNEY, Chief Engineer.

The Effects of Cold on Iron and Steel.

[Continued from Page 565.]

THE PROPERTIES OF IRON AND STEEL.

A paper "On the Properties of Iron and Steel as applied to the Rolling Stock of Railways," by Sir W. Fairbairn, Bart., LL. D., F. R. S., etc., was also read. The writer said: Dr. Joule communicated to me the discussion which took place at the last meeting of the society, on the question of the effects of intense cold on steel tires. This enables me to refer to a series of experiments which had for its object the effects of various degrees of temperature on wrought iron. These inquiries are to some extent analogous to the cause of the recent accident which occurred on the Great Northern Railway, near Hatfield, by the breaking of a steel tire, which caused the death of a number of persons. It has been asserted, in evidence given at the coroner's inquest, that the breaking of the steel tire was occasioned by the intensity of the frost, which is supposed to render the metal brittle, and of which this particular tire was composed. This is the opinion of most persons, but, judging from my own experience, such is not the fact; and provided we are to depend on actual experiment, it would appear that temperature has little or nothing to do with it. Some years since I endeavored to settle this question by a long and careful series of experiments on wrought iron, from which it was proved that the resistance to a tensile strain was as great at the temperature of zero as it was at 60° or upwards, until it attained a scarcely visible red heat. To show that this was the case, and taking, for example, the experiments at 60°, it will be found that the mean breaking weight, in tons, per square inch, was in the ratio of 19.930 to 21.879, or as 1 is to 1.098 in favor of the specimens broken at the temperature of zero. The generally received opinion is, however, against these facts, and it is roundly asserted that the strength of iron and steel is greatly reduced in strength at a temperature below freezing. The contrary was proved to be the case in wrought-iron plates, and assuming that steel follows the same law, it appears evident that we must look for some other cause than change of temperature for the late fracture of the tire on the wheel of the brake van of the Great Northern Railway. The immense number of purposes to which both iron and steel are applied, and the changes of temperature to which they are exposed, renders the inquiry not only interesting in a scientific point of view, but absolutely necessary to a knowledge of their security under the various influences of those changes; and when it is known that

most of our metal constructions are exposed to a range of temperatures varying from the extreme cold of winter to the intense heat of summer, it is assuredly desirable to ascertain the effects produced by those causes on material from which we derive so many benefits, and on the security of which the safety of the public frequently depends. It was for these reasons, that the experiments in question were undertaken, and the summary of results are sufficiently conclusive to show that changes of temperature are not always the cause of failure, as that which occurred near Hatfield on the Great Northern Railway. That such is the fact I may adduce several accidents of broken tires, all of which occurred during the spring and summer months when the temperature was high. One of them occurred on the Lancashire & Yorkshire Railway in the summer of the last year, when the temperature was 50° to 60° above freezing. I could enumerate others in which the winter frosts had nothing to do with the fractures which ensued. It might have been satisfactory to have shown the process by which the following results were obtained; suffice it to observe that all the specimens were torn asunder with and across the fiber in oil and water baths, and those under the freezing point were made in a snow bath reduced to zero. The experiments are quite conclusive as regards the strength of wrought-iron plates, till they approach red heat. At that temperature nearly one-half the strength is lost; it becomes exceedingly ductile, and may be drawn to a considerable extent in the direction of the fibers before it breaks. Another series of experiments were made on wrought-iron bars, which indicated somewhat different results. In these experiments, the specimens from the same works attained the maximum of strength, and gave at a temperature of 415°, a resistance of 39.072 tons per square inch, and at zero and 60° there were little or no differences, excepting in the case of temperature, when the resistance was increased from 28.419 at zero and 60° to 39 tons per square inch at 415°. This may, however, be accounted for from the increased manipulation of rolling where the fiber is drawn and elongates to a much greater extent than in plates. This does not, however, affect to any great extent the ratio of compression and extension as regards the effects of temperature, although I should be inclined to take the experiments on plates before that on bars, as analogous to the broken tire, which, it must be borne in mind, is without weld and perfectly homogeneous. The danger arising from broken tires does not, according to my opinion, arise so much from the changes of temperature as from the practice of heating them to a dull red heat, and shrinking them on to the rim of the wheels. This, I believe, is the general practice, and the unequal and, in some cases, the severe strains to which they are subject, has a direct tendency to break the tires. To show how easily this may be effected, let us suppose that a tire 2 ft. 6 in. or 3 ft. diameter, is shrunk on to a wheel 1-10 in. larger than the tire, it then follows that the tire in cooling must be elongated to that extent, with a strain equivalent to the force of the shrinkage and calculated to produce that amount of molecular disturbance. It may be more or it may be less, but supposing the strain to be one-half or three-fourths of that which would break the tire, it then follows that the constant action of its irregular motion on the rails must ultimately lead to fracture.* I am not surprised that this should be the case, as most, if not the whole, of railway tires, excepting those on engines and tenders, are not turned but selected by hand, heated and shrunk upon the wheels with every degree of tension, as suits the convenience of the workmen. So long as this process is pursued, the public will be exposed to the risk of broken tires. What is required in this description of manufacture is, that the rim of the wheel and the inside of the tire should be turned to a standard gauge, accurately calculated to give the required amount of tightness with a larger margin of strength; and this done we should attain greatly increased security to the public, and a great saving in wear and tear—to say nothing of the large sums expended by companies in the shape of compensation for injuries and loss of life.

ON THE ALLEGED ACTION OF COLD RENDERING IRON AND STEEL BRITTLE.

A paper "On the Alleged Action of Cold in rendering Iron and Steel Brittle," was read by Mr. J. P. Joule, D. C. L., F. R. S., etc., Vice-President. As is usual in a severe frost, said Mr. Joule, we have recently heard of many severe accidents consequent upon the fracture of the tires of the wheels of railway carriages. The common-sense explanation of these accidents is, that the ground being harder than usual, the metal with which it is brought into contact is more severely tried than in ordinary circumstances. In order apparently to excuse certain railway companies, a pretence has been set up that iron and steel become brittle at a low temperature. This pretence, although put forth in defiance not only of all we know of the properties of materials, but also of the experience of every-day life, has yet obtained the credence of so many people that I thought it would be useful to make the following simple experiments: 1. A freezing mixture of salt and snow was placed on a table. Wires of steel and of iron were stretched so that a part of them was in contact with the freezing mixture, and another part out of it. In every case I tried the wire broke outside of the mixture, showing that it was weaker at 50° F. than at about 12° F. 2. I took twelve darning needles of good quality, 3 in. long, 1-24 in. thick. The ends of these were placed against steel props, 2 1/2 in. asunder. In making an experiment, a wire was fastened to the middle of a needle, the other end being attached to a spring weighing machine. This was then pulled until the needle gave way. Six of the needles, taken at random, were tried at a temperature of 55° F., and the remaining six in a freezing mixture,

which brought down their temperature to 12° F. The results were as follows:

Warm needles.	Cold needles.
64 " " broke	55 " " broke
65 " " "	64 " " "
65 " " "	72 " " "
62 " " "	60 " bent
44 " " "	65 " broke
60 " bent	40 " "

Average 58 1/2

59 5-6

I did not notice any perceptible difference in the perfection of elasticity in the two sets of needles. The result, as far as it goes, is in favor of the cold metal. 3. The above are doubtless decisive of the question at issue. But as it might be alleged that the violence to which a railway wheel is subjected is more akin to a blow than a steady pull; and as, moreover, the pretended brittleness is attributed more to cast iron than any other description of the metal, I have made yet another kind of experiment. I got a quantity of cast-iron garden nails, 1 1/4 in. long, and 1/4 in. thick in the middle. These I weighed, and selected such as were nearly of the same weight. I then arranged matters so that by removing a prop, I could cause the blunt edge of a steel chisel, weighted to 4 lbs. 2 oz., to fall from a given height upon the middle of the nail as it was supported from each end, 1-16 in. asunder. In order to secure the absolute fairness of the trials, the nails were taken at random, and an experiment with a cold nail was always alternated with one at the ordinary temperature. The nails to be cooled were placed in a mixture of salt and snow, from which they were removed and struck with the hammer in less than 5 seconds. Up to series 10, each set of 16 nails was made up of those of the previous set which were left unbroken, added to fresh ones to make up the number: Series 1. Temperature of eight cold nails, 10°; of eight warm, 36°; height of fall of hammer, 2 in. Result: No nails broke. Series 2. Temperature of eight cold nails, 14°; of eight warm ones, 36°; fall of hammer, 2 1/2 in. Result: No nails broke. Series 3. Temperature of eight cold nails, 2°; of eight others, 36°; fall of hammer, 3 in. Result: One cold nail broke; no warm ones broke. Series 4. Temperature of eight cold nails, 2°; of eight others, 36°; fall of hammer, 3 1/2 in. Result: Two cold nails broke; one warm one broke. Series 5. Temperature of eight cold nails, 2°; of eight others, 36°; fall of hammer, 4 in. Result: One broke of each sort. Series 6. Temperature of eight cold nails 0°; of eight others, 38°; fall of hammer, 4 1/2 in. Result: One broke of each sort. Series 7. Temperature of eight cold nails, 2°; of eight others, 36°; fall of hammer, 5 1/2 in. Result: No cold nail broke; one warm nail broke. Series 8. Temperature of eight cold nails, 2°; of eight others, 40°; fall of hammer, 6 1/2 in. Result: Two cold nails broke; one warm nail broke. Series 9. Temperature of eight cold nails, 2°; of eight others, 40°; fall of hammer, 7 1/2 in. Result: Three cold nails broke; three warm nails broke. Series 10. Experiment with the ten left in the last; temperature of five cold nails, 2°; of the five others, 40°; fall of hammer, 8 1/2 in. Result: Two cold nails broke; one warm nail broke. Series 11. Experiment with the six left from the last; temperature of three cold nails, 3°; of the other three, 40°; fall of hammer, 10 in. Result: Two cold nails broke; three warm nails broke. Series 12. Experiment with fresh nails: Twelve cooled for four hours to 3°; twelve others, 41°; fall, 7 in. Result: Seven cold nails broke; eight warm nails broke. The collective result is that 21 cold nails broke and 20 warm ones. The experiments of Lavoisier and Laplace, of Smeaton, of Dulong and Petit, and of Troughton, conspire in giving a less expansion by heat to steel than iron, especially if the former is in an untempered state. Such specimens of steel wire and of watchspring as I possess expand less than iron. But this, as Sir W. Fairbairn observed to me, would in certain limits have the effect of strengthening rather than of weakening an iron wheel with a tire of steel. The general conclusion is this: Frost does not make either iron (cast or wrought) or steel brittle, and that accidents arise from the neglect of the companies to submit wheels, axles, and all other parts of their rolling stock to a practical and sufficient test before using them.

ON THE EFFECT OF COLD ON THE STRENGTH OF IRON.

A paper "On the Effect of Cold on the Strength of Iron," was read by Mr. Peter Spence, F. C. S., etc. In the conversation at the last meeting of the Society, he said: On one of the causes of railway accidents, namely, the breaking of the tires of the carriage wheels, there was a general expression of opinion that the reduction of temperature during frost had the effect of reducing the strength of iron, and that this was the proximate cause of these occurrences. Dr. Joule, on the other side, stated that however general the impression might be, he knew of no experiments that tended to prove that impression to be a correct one. It seemed to me that a few experiments on cast iron could, without much difficulty, be made, and which might set the matter at rest one way or the other. I therefore decided on having some lengths of cast iron made of an uniform thickness of 1/2 in. square, from the same metal and the same mold; these I obtained after a good deal of trouble, on account of the molders being off work at New Year's time, and this must be my excuse for not being able to give due notice of my communication. Two of the four castings I got seemed to be good ones, and I got the surface taken off and made them as regular a thickness as was practicable. I then fixed two knife-edged wedges upon the surface of a plank, at exactly 9 in. distance from each other, with an opening in the plank in the intervening space; the bar being laid across the wedges a knife-edged hook was hung in the middle of the suspended piece of the bar; to the hook was hung a large scale, on which to place weights. The bar was tried first at a temperature of 60° Fahr.; to find the breaking weight, I placed 56 lb. weights one after another on the scale, and when the ninth was put on the bar snapped. This was the only unsatisfactory experiment, as 14 lbs. or 28 lbs. might have done it, but I include it among the others. I now adopted another

precaution, by placing the one end of the plank on a fixed point and the other end on to a screw jack, by raising which I could, without any vibration, bring the weight to bear upon the bar. By this means, small weights, up to 7 lbs., could be put on while hanging, but when these had to be taken off and a large weight put on, the scale was lowered to the rest, and again raised after the change was made. I may here state that a curious circumstance occurred twice, which seems to indicate that the mere raising of the weight without the slightest apparent vibration, was equal in effect to an additional weight; 3 1/4 cwt. were on the scale, 14 lbs. weight was added, then 7 lbs., then 4 lbs., 2 lbs., 1 lb., and 1 lb., making 4 cwt. and 1 lb. This was allowed to act for from one to two minutes, and then lowered to take off the small weights, and replaced by a 56 lb., intending to add small weights when suspended, and raised so imperceptibly by the screw that the only way of ascertaining that it was suspended was by looking under the scale to see that it was clear of the rest. As soon as it was half an inch clear it snapped, thus breaking at once with one pound less than it resisted for nearly two minutes. Six experiments were carefully conducted at 60° Fahr., the parts of the bars being selected so as to give each set of experiments similar portions of both bars; the results are marked on the pieces. My assistant now prepared a refrigerating mixture which stood at zero, and the bars were immersed for some time in this, and we prepared for the breaking trials to be made as quickly as could be, consistently with accuracy, and to secure the low temperature, each bar, on being placed in the machine, had its surface at top covered with the freezing mixture. The bars at zero broke with more regularity than at 60°, but instead of the results confirming the general impression as to cold rendering iron more brittle they are calculated to substantiate an exactly opposite idea, namely, that reduction of temperature *ceteris paribus* increases the strength of cast iron. The only doubtful experiment of the whole twelve is the first, and as it stands much the highest, the probability is that it should be lower; yet, even taking it as it stands, the average of the six experiments at 60° Fahr. gives 4 cwt. 4 lbs. as the breaking weight of the bar at that temperature, while the average of the six experiments at zero gives 4 cwt. 20 lbs. as the breaking weight of the bar at zero, being an increase of strength from the reduction of temperature equal to 3.5 per cent.

Mr. William Radford, C. E., asked if Mr. Brockbank had considered what the effect must be upon iron used in Russia, Sweden, Norway, and Denmark; for if the theory which was sought to be established were true, the tires of railway wheels in those countries must fly to pieces in winter. As far as his experience went in Denmark, such had not been the case on the Copenhagen Railway.

Planting Forest Trees on the Prairies.

BY H. W. S. CLEVELAND.

The following article, which we copy from the *Western Rural*, with some additions from the author, was originally contributed by the author, a well known landscape architect of this city, to the *New York Weekly Tribune*, in which a part of it appeared as an editorial. The great importance of the future wood and timber supply for our Western railroads makes this one of the most important subjects for the consideration of their managers:

I hold it to be true, and the purpose of this article is to show, that forest culture on the great prairies is an essential preliminary to their settlement.

In the well known "Report on the Trees and Shrubs of Massachusetts," by Geo. B. Emerson, published in 1846, by order of the Legislature, may be found the following passage:

"The importance of the forests as furnishing materials for ship-building, house-building, and numerous other arts, is so obvious that it must occur to every one; and yet there is danger that, in many places, from false motives of immediate economy, no provision will be made for the wants of future generations. It is not easy to estimate the pecuniary value of the wood used in housebuilding. A vast deal of this is continually going on; the aspect of the State is annually everywhere improving, by the erection of larger, better finished, and more commodious houses, barns and out-houses. But no returns of these improvements are published. The thousands of tons of timber, boards, clapboards and shingles, are not put on record. As to ship-building, we have some data. The returns from the various towns in the State, made in 1837, show that the average annual value of ships built in the five preceding years was \$1,370,649.

The effect of the wasteful destruction of the forest trees is already visible. A very large proportion of the materials for ship-building, house building and manufactures, are now brought from other States. Every year we are more dependent on Maine and New York and some of the Southern States, not only for ship-timber and lumber for house-building, but for materials for tanning and dyeing, carriage-building, basket-making, last-making, furniture, and the implements of husbandry. Even these foreign resources are fast failing us. Within the last quarter of a century the forests of Maine and New York, from which we draw our largest supplies, have disappeared more rapidly than those of Massachusetts ever did. In a quarter of a century more, at this rate, the supply in many places will be entirely cut off."

The warning embodied in these words was suffered to pass unheeded; the quarter of a century has passed since they were uttered, and the prediction is more than fulfilled. The rate of demand on which it was based has increased to a degree which would then have appeared incredible; and while we have still to regret the want of any record by which an estimate can be formed of the actual amount of timber annually drawn from the forests, or of the probable duration of the

* From long-continued action under strain, it has been proved that it is only a question of time when rupture takes place, as repeated increase and diminishing of the same load ultimately leads to fracture.

present sources of supply, yet, if we consider the amount of timber required to meet the demand for the single item of railroad construction, which at the time the above was written was not of sufficient importance to demand consideration, and give a moment's thought to what it must be in the not distant future, we cannot fail to be convinced that the work of providing for it has become a matter of national importance, which it were worse than folly to postpone.

Few persons not concerned in railroad construction have any realizing sense of the draft it involves upon the natural supplies of timber; and few even of those so engaged have considered, as it deserves, the problem of future supply for the region, larger than the present settled portion of the United States which is now opened to us between the Missouri and the Rocky Mountains, a prairie country, rich in all resources except timber, the one thing needful for the development of its agricultural and mineral wealth.

The *Railroad Journal*, of January 1, 1870, says: "The construction of the Pacific railroad has forced all parts of the country to railroad extension; and hence we find that the extent of mileage constructed and improvement on old lines, has been greater in 1869 than in any previous year of railroad history. When we state the fact that no less than 6,588 miles of new road have been brought into use during the year, this fact is fully proven. This is more than one-eighth part of the total mileage in the country, the other seven-eighths having taken forty years to establish. We have now in use an estimated mileage of 45,860 miles of railroad in the United States."

That the multiplication of railroads must go on in a constantly increasing ratio, is as certain as that the population of the country must continue to increase. Every mile of railroad requires 2,700 sleepers, or ties, which, in the West, are mostly of oak or chestnut, and are now worth 50 cents each, or \$1,350 per mile. They are generally made of comparatively young wood; that is, of trees not more than eight or ten inches in diameter, requiring only to be hewn flat on the upper and under surface. The average number of sleepers cut from a single tree of this size is probably not more than two; but allowing it to be three, which it cannot exceed, we find the number of trees required to furnish ties for the railroads already constructed to be upwards of four millions. Estimating the yield of a single acre at 400 trees, it will be seen that 10,000 acres must be stripped to furnish this supply. But as such a yield would rarely, if ever, be obtained, it is safe to say that 15,000 acres must be cleared of timber every eight years, to furnish simply the ties required for the railroads already in operation. The fact that it is made up by contributions from widely distributed sections, while it renders the destruction less perceptible, in no degree reduces the actual aggregate. It is true that a better economy is beginning to prevail in some parts of the West where railroad companies have bought large tracts of forest, and established mills for sawing the timber, so that they avoid the wasteful necessity of using only young timber. The fact of the adoption of such a measure of economy is, in itself, an evidence of the sense of future necessities which impelled it. A consideration of future wants will show that much more efficient measures are required than can be met by any possible economy of existing sources of supply. Thus far I have considered only the requirements of a single item of railroad construction, and that, the first item after the road is graded, and preliminary to laying the rails, leaving out of sight the demands involved in the construction of bridges, fences, and buildings, for the completion of the road, and the enormous quantity required for the rolling stock. Col. J. W. Foster, in his valuable work on "The Mississippi Valley," says:

"The destruction of forests in the United States is going on at an accelerating pace. The lumber trees of Maine, in accessible positions, are nearly exhausted; and twenty years will accomplish the same result with regard to the extensive pineries of Michigan and Wisconsin. The destruction of hard wood timber is going on with equal rapidity. To one who realizes how rapidly the sources of supply are being exhausted, it cannot but be disheartening. The Pacific railroads, which traverse, for long distances, the valleys of the Kaw and Platte, have consumed in their construction nearly every stick of timber, and in four years will have consumed all the firewood."

The report of the State Inspector of Michigan on the lumber trade, for the year 1869, states the amount of lumber cut during the year to be 2,029,372,255 feet, valued at \$34,000,000, and estimates the value of that which remains at \$300,000,000; "and it is thought that fifteen or twenty years will be required to cut and send to market the trees now standing."

[To be continued.]

The Action of Steam in the Cylinders of Locomotives.

BY FRED. J. SLADE.

[Continued from Page 556.]

Theoretical Curve of Expansion.—In order that we may discover the action that takes place in the cylinder of any steam engine during the period of expansion, we must draw on the indicator diagram the curve which shall represent exactly the successive pressures that would have existed had the steam expanded without loss or gain of heat from any external source, and without loss or gain of pressure from leakage at the valves or past the piston. The departure of the actual curve, shown on the diagram, from this theoretical curve of expansion, exhibits what increase or diminution of weight the steam has undergone, and we have then only to decide to what causes this is due.

The facts which we have just considered will instruct us as to the manner in which the true theoretical curve is to be constructed. It is evident that we must allow, in drawing this line for the loss of pressure resulting from the condensation produced by the conversion of heat into the work performed by the steam, deducting,

however, from this amount of heat abstracted, the quantity of heat set free, due to the greater total heat normal to the steam at its higher initial pressure than that normal to it at its pressure after expansion, since this gain and loss are inseparable from the expansion of the steam, and the resultant pressures which they give rise to are those which the steam in the cylinder would actually have were it entirely unaffected by external influences.

This point appears to have been generally overlooked by writers on this subject, and the theoretical curve has been laid down either according to the law of Boyle and Mariotte, that the pressures are inversely as the volumes, or, more properly, from a table giving the pressures of steam corresponding to different relative volumes, as determined by experiments upon the evaporation of a given weight of water under different pressures. As we have just shown, the fact of the expansion line of a diagram agreeing with a curve constructed in this manner, would prove that heat or steam had been derived from some external force to supply the loss due to the conversion of heat into work, and hence it cannot be taken as the theoretical curve for purposes of comparison.

In order, then, to construct the true curve, we first determine the exact volume of steam contained in the cylinder at the moment of suppression, including the contents of the clearance space and steamways expressed in inches of length of the cylinder. In a table of the properties of saturated steam, we find the relative volume of steam at the initial pressure. Then, for each successive point of the stroke we multiply this quantity by the ratio in which the volume of steam in the cylinder has been expanded, and ascertain from the table the pressure corresponding to the relative volume so obtained. These pressures laid down on the diagram at the points for which they have been obtained, and connected by a curve, will give the theoretical curve as ordinarily constructed, and which may properly be called the curve of relative pressures and volumes of saturated steam. Now, to render it correct as a datum line for comparison with the actual curve of the diagram, we must ascertain, in the manner already explained, the amount of reduction of final pressure due to the work which has been performed by the steam during its expansion, and deduct this from the final pressure given by the curve already constructed. A hyperbolic curve starting from the same point as the previous one, and terminating at the point so found, will be the true theoretical curve of expansion.

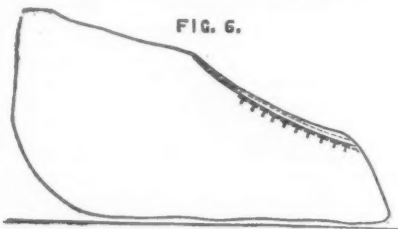


Fig. 6 shows a diagram from a cylinder 18 in. x 20 in., in which the true curve has been laid down in this manner, as shown by the full line. The dotted line is the curve as usually drawn. In this case the suppression occurs when the steam occupies a space equal to 11 in. in the length of the stroke, and the piston moves nearly 8 in. further before the opening of the exhaust. The initial pressure is 97 lbs., and at the time of opening of the exhaust the indicated pressure is 51 lbs., which is $3\frac{1}{2}$ lbs. above the true curve as shown by the full line beneath. The latter falls 2 lbs. below the dotted curve. The excess of $3\frac{1}{2}$ lbs. in the indicated over the theoretical pressure shows an addition of $7\frac{1}{2}$ per cent. to the initial quantity of steam during expansion. It is impossible to tell, in the absence of data as to the condition of the valve, how much of this accession of steam is due to leakage at the valve face, and how much is due to the re-evaporation of water condensed during the first part of the stroke, but as this process of evaporation goes on still more rapidly during the exhaust, it will be seen that if the rise of pressure indicated is due to this cause, then the quantity of steam condensed during admission must have been considerable. It will be observed, however, that the indicated line begins to rise above the theoretical curve immediately after the suppression of the steam, and before the pressure has fallen off sufficiently to give rise to any considerable amount of evaporation, and it is possible, therefore, that the gain is in good part due to leakage at the valve.

The two diagrams, Figs. 4 and 5, given on page—of our last number but one, throw considerable light on the influence of speed on the amount of condensation due to the temperature of the cylinder, and, though not from locomotives, they will aid us in the study of the action of steam during expansion. They are from an engine with a partially steam-jacketed cylinder of 36 in. diameter by 48 in. stroke, fitted with single beat poppet valves, which, at the time these diagrams were taken, were new, and in good condition, so that it is unlikely there was any leakage whatever at the valves. The first, taken with a pressure of steam of 35 lbs., and a speed of 25 revolutions per minute, exhibits an expansion line which agrees very closely at first with the theoretical curve, falling, however, about 4 lbs. below it between the point of cutting off and the third-tenth of the stroke, at which point it crosses the curve and continues to rise above it till the end of the stroke, at which point it shows a pressure of $3\frac{1}{2}$ lbs. in excess of the theoretical pressure. The second, taken from the same cylinder with 31 lbs. of steam, and at 12 revolutions, shows that the pressure, after the closing of the steam valve, fell 2 lbs. below the theoretical curve, rising again so as to cross this curve at $3\frac{1}{2}$ tenths of the stroke, and reaching a point at the time of opening the exhaust, 5 lbs. above the theoretical pressure. In this case the extremes of variation in each direction

from the theoretical curve are considerably greater than at the higher speed, and this is easily accounted for by the fact that at the slower speed a larger quantity of water was evaporated by the cylinder in the latter part of the stroke and during the exhaust, and its temperature accordingly lowered in the same proportion, thereby causing an increased condensation at the commencement of the stroke. This fact, which these diagrams so clearly bear witness to, forms, as we have already said, an important argument in favor of high-speed engines, since although there is apparently a gain by the rise of pressure at the end of the stroke greater than the loss by its fall at the commencement of expansion, yet as this re-evaporation continues even more rapidly during the return stroke, when it can supply no useful pressure, the cylinder is thereby cooled to such an extent as to cause the condensation of a much greater quantity of steam on its admission than can be re-evaporated during expansion. In the slow-speed diagram before us, the theoretical pressure at the time of opening of the exhaust would have been but $7\frac{1}{2}$ lbs. above a vacuum, and the fact that the indicated pressure is $12\frac{1}{2}$ lbs., shows that a quantity of steam, no less than 59 per cent. of what was contained in the cylinder at the time of cutting off, has been added by re-evaporation of water condensed during the admission of the steam. Under such circumstances it is clear a very considerable loss must occur from this cause.

The analysis of a number of diagrams taken from the same engine shows that the amount of departure of the actual pressure at the end of the stroke from that indicated by the theoretical curve bears a certain relation to the extent to which expansion has been carried. The following table contains the data given by a number of diagrams taken by the writer from engines of the Erie Railway, U. S.

Engine.	Cut-off.	Revolutions per minute.	Percentage of expansion.	Percentage of difference of final pressure.
No.				
204	.35	204	2.6	+13.1
155	.40	36	2.25	+3.7
205	.42	90	2.14	+10.
203	.42	210	2.14	+15.
204	.45	40	2.	+3.9
155	.50	84	1.8	+0.8
204	.50	168	1.8	+6.1
203	.50	168	1.8	+5.6
155	.50	148	1.8	+6.3
155	.52	53	1.7	+5.6
155	.55	77	1.6	+1.6
203	.55	122	1.6	+6.1
246	.55	76	1.6	0.
155	.60	72	1.5	0.
155	.60	74	1.5	-1.9
155	.66	36	1.4	-1.9
246	.77	30	1.2	-6.

In the column headed "Cut-off" is given the percentage of the whole capacity of the cylinder, including clearance, which was filled with steam at the moment of closing of the valve, as nearly as the latter can be determined by the curve on the indicator diagram. The difference of final pressure is measured at the point where the volume is nine-tenths of the total capacity, this being about the point at which the release commences. The sign + indicates that the final pressure was in excess of the theoretical amount, and conversely the sign — that the actual pressure fell below the theoretical curve. All the engines had inside cylinders 18 in. x 20 in., except No. 246, which had outside cylinders 18 in. x 22 in. lagged with wood and covered with brass, as usual on American engines. Taking an average of the foregoing results, it would appear that with all rates of expansion greater than 1.5, that is, with the steam admitted until .60 of the cylinder has been filled and then expanded to a volume of .90, there results an excess of final pressure over that theoretically to be expected, and for less measures of expansion a deficiency of final pressure results. The average of the results would indicate that for assumed periods of 30 and 100 per cent. of admission there would be an excess of pressure in the one case corresponding to an increase in the weight of live steam of 15 per cent., and a deficiency in the other of 17 per cent. of the quantity contained in the cylinder at the commencement of expansion.

No difference appears to exist, in this respect, between the inside and outside cylinders, the same general average answering equally well for both. The speed at which the engine is working appears, at first sight, to affect the discrepancy of pressure in the opposite direction from what we should anticipate, as it will be seen from the table that, as a rule, the higher the speed the greater is the excess of final pressure, while for low speeds the excess is quite small. This is, however, undoubtedly due to the fact that the diagrams at slow speed were taken while starting from the stations, and the less rise of final pressure is, in these instances, accounted for by the comparative coolness of the cylinder. The great amount of re-evaporation taking place with high rates of expansion, indicating, as it does, a still larger condensation of high-pressure steam during admission, shows a source of loss which tends to reduce, in a certain measure, the economic gain theoretically derivable from large ratios of expansion. It will be evident, however, from what has been said, that if by any means we can prevent the condensation of steam during admission, then there will be no water to be re-evaporated during the last portion of the stroke and during the exhaust, and consequently the cylinders will not undergo the chilling action which usually results from that process, and, as a consequence, the initial loss will be avoided. This end may be partially effected by the use of a steam jacket, or more perfectly by the use of superheated steam, and where the full economy due to high measures of expansion is desired, some such prevention of condensation should be employed.—*Engineering.*

[To be Continued.]

General Railroad News.

OLD AND NEW ROADS.

New York & Oswego Midland.

This company has leased the Midland & Crawford Railroad, running north from Middletown, for the term of 99 years. The directors are also negotiating for a lease of the Middletown, Unionville & Water Gap Railroad, running south from Middletown.

Pittsburgh & Connellsville.

This company received recently from Wilmington, Delaware, several first-class passenger cars, with all the modern improvements, and President Hughart has contracted for Pullman palace sleeping cars, to be delivered in thirty days.

Washington & Richmond.

The Governor of Virginia has signed the bill chartering the Washington & Richmond Railroad Company, some of the conditions of which, says the *Baltimore Sun*, are not likely to be very burdensome to the Pennsylvania Railroad, in whose interest it was passed, to wit: the indorsement of the bonds of the Norfolk & Great Western road by the Pennsylvania Company is not required till \$2,000,000 of solvent subscriptions have been made to the stock of the road, and no one knows where they are to come from; and the guarantee of \$15,000 per mile to the bonds of the Piedmont & Potomac road by the Pennsylvania Company, another of the conditions of Washington & Richmond charter, is only for the superstructure and equipment of that road. Of course the road-bed must be made from means otherwise raised before this guarantee can be demanded. This road is to run from the Chain Bridge, or the Aqueduct Bridge, on the Potomac, near Georgetown, to Aldie, in Loudon, and thence to the Alexandria & Manassas road, at or near Rectortown, and thence to the Shenandoah Valley road, at or near Luray.

Flushing & Newtown.

This branch of the Long Island Railroad to Flushing has been incorporated under the General Railroad act, and called the Flushing & Newtown Railroad. The following are the officers of the company: The Hon. E. A. Lawrence, President; Joseph F. Franklyn, Vice-President; R. Sands Tucker, Secretary. In addition to the officers, the Hon. Robert B. Roosevelt, G. R. Garretson, John Henderson, Eugene Lynch, Thomas Gasten and B. W. Downing are directors. The capital stock of the company is \$100,000, and \$120,000 worth of bonds will be issued, guaranteed by the Long Island Railroad. The map of the route has been forwarded to Albany. It will leave the Long Island road at Winfield, run direct through the center of Newtown village, and enter Flushing about one-quarter of a mile south of the Flushing & North Side Railroad Bridge. A bill granting the road the privilege of crossing Flushing Creek with a draw has been forwarded to Albany. The trustees have asked the consent of the Flushing trustees to enter the village. The road will be leased and run by the Long Island Railroad.

Springfield & Illinois Southeastern.

We mentioned some weeks since the completion of this road west from Springfield to Ashland. The track is now laid several miles beyond Ashland, and, it is expected, will reach the Illinois River at Beardstown about the 1st of June.

St. Louis & Southeastern.

The Mt. Vernon, Ill., *Free Press* learns that the road, which now terminates at that place, is graded, at the other end of the line, from Evansville to the Wabash River, via Mt. Vernon, Indiana.

Quincy, Missouri & Pacific.

Governor Palmer will veto the bill authorizing the city of Quincy to issue \$500,000 of bonds in aid of this road, which, we may say, ought to be so good a property as to justify its construction without a subsidy.

Western Maryland.

A large force is employed on the extension of this road between Mechanicsburg, in Frederick County, and Smithsburg, in Washington County, and satisfactory progress is made.

Baltimore & Potomac.

The Port Tobacco *Times* says that work upon the Baltimore & Potomac Railroad is steadily progressing, and at this time one-half the grading within Charles County has been completed. At the Pope's Creek end of the line, Colonel Cox, the contractor, has about two hundred hands at work. This is the road by which the Pennsylvania Company is to reach Richmond, by connecting at the Potomac with its recently chartered Washington & Richmond Railroad, provided that the old Acquia Creek line will not come to terms.

Quincy & Carthage.

This railroad, which was constructed by the Quincy & Warsaw Railroad Company and has been operated

by the Chicago, Burlington & Quincy Company as an extension of its Carthage & Burlington Branch, has, it is reported, been personally transferred to the latter company, the stock having been delivered to James F. Joy on the 6th inst.

St. Paul & Sioux City.

Arrangements have been made, it is reported, which insure the completion of this road to Sioux City by October 1, 1872.

Richmond, Danville & Piedmont.

It is said that the Pennsylvania Company has obtained possession of this road, which extends from Richmond, Va., southwestward to Greensboro', N. C., 189 miles, and that it will construct a line from Greensboro', due south to Cheraw, S. C. near the State line, to connect there with the Cheraw & Darlington Railroad to Florence, S. C., and there with the Northwestern Railroad to Savannah, forming a due south line from Greensboro' to Charleston. The length of the road to be built is about 100 miles, and the whole distance from Richmond to Charleston by this route will be about 430 miles, which is about 25 miles shorter than the present route, by way of Weldon and Wilmington.

Rockford Central.

The Rockford *Gazette* learns that this company has been reorganized, and that it is intended to complete a line from St. Louis to Milwaukee by way of Jacksonville, Lacon, Henry, Peru, Mendota, Rochelle, Rockford and Beloit. Whether this is to be done by building a new line the whole distance, or by one or two short sections, is not made known; or, indeed, whether there is any reasonable probability that any part of the road will be constructed. R. P. Lane, T. D. Robertson and R. Emerson, of Rockford, are members of the directory.

Winona & St. Peter.

The Railroad Investigating Committee of the Legislature included in their late report the following facts concerning the company. The business for 1870 was:

Gross earnings.....	\$374,667 98
Expenses (including repairs).....	465,268 10
Net earnings.....	109,399 88
Average freight per ton per mile.....	5 97-100 cts.
Average per mile for passenger.....	4 8-10 cts.

The company has adopted a system of half fare and commutation tickets—selling tickets good for a thousand miles' travel over the road for thirty dollars.

The elevators are mostly owned by the company, and the rules are made by the company. The tariff on wheat covers all expenses of receiving, weighing, loading into cars, and forwarding. Wheat is graded by the Chicago and Milwaukee standard.

Number of miles of road constructed.....	138
Cost of construction to Jan., 1871.....	\$4,754,836 84
Interest on same at 7 per cent.....	338,838 98

Not included in cost of construction:

Equipments.....	\$427,10
Interest on same.....	29,897

This company has acquired from the State 363,335 80-100 acres of land, estimated at \$5 per acre.

There have been sold 31,131 90-100 acres for \$220,695.21, of which there has been received by the company \$121,578.62. Average price, \$7.08 per acre.

Missouri, Kansas & Texas.

Track laying from Chetopa, south, 90 miles in the Indian Territory, to the Arkansas River was to have commenced this week. The road-bed is ready and the bridge material is ready for delivery.

Kentucky Aid to Railroads.

D. Howard Smith, Auditor of Kentucky, has compiled a complete list of the railroads aided by the different counties and towns of the State, giving the amount of aid pledged by every place. The aid as distributed among the railroads was as follows:

Bardstown & Louisville.....	\$60,000
Cumberland & Ohio.....	2,200,000
Covington & Lexington.....	673,000
Danville & McMinnville.....	300,000
Evansville, Henderson & Nashville.....	679, 00
Elizabethtown & Paducah.....	2,698,000
Glasgow Branch.....	125,000
Jeffersonville.....	167,000
Louisville, Harrodsburg & Virginia.....	300,000
Louisville & Nashville.....	2,115,300
Lebanon Branch.....	568, 00
Lexington & Big Sandy.....	584,000
Lexington & Danville.....	218,000
Mayville & Lexington and Lexington & Covington.....	84,000
Mayville & Lexington.....	367,333
Mayville & Lexington and Mayville & Sandy.....	240,000
Madisonville & Shawneetown Straight-Line.....	105,000
Nashville & Northwestern.....	37,000
New Orleans & Ohio.....	300,000
Owensboro & Guthrie.....	400,000
Owensboro & Russellville.....	947,350
Richmond Branch.....	717,000
St. Louis Air-Line.....	600,000
Shelbyville.....	540,000
Total.....	\$14,938,968

Erie Railway.

The English stockholders have at last been successful in one case, and have now got their stock into their own hands again. It will be remembered that their representative, Mr. Robert A. Heath, sent 60,000 shares of stock to the company's office previous to the last election for directors, to be properly entered on the

company's book, as was necessary in order to vote upon it. While there the company made some charge against the holders of this stock and procured an order from Judge Barnard placing their stock in the hands of a receiver. The case was finally transferred to the United States Circuit Court, where, it seems, the Erie Company did not feel quite certain of a favorable decision, for when the case came up its counsel informed the defendant that the suit was withdrawn at plaintiff's cost. Judge Blatchford decided, however, that the notice was informal and insufficient, and proceeded with the case. The Erie Company did not appear in court, and a motion for the removal of the receiver was granted, and he was directed to turn over the stock to the Clerk of the Court in trust for the defendants. So, after all, the case was not decided on its merits, but was virtually a non-suit. As the stockholders were effectually prevented from voting on their stock at the last election, probably their opponents gained their object by the suit.

Northern Pacific.

A telegram from St. Paul, dated the 13th inst., says that the Northern Pacific Railroad Bridge across the Mississippi River at Brainerd, Minn., was finished that day, and the first passenger train, containing officers of the road, passed over the structure. This completes the Northern Pacific 113 miles west from Lake Superior. The grade is finished nearly to Red River, 150 miles further, and at the present rate of progress, trains will run to Red River before September next.

St. Louis & Keokuk.

Mr. Joy, representing the Hannibal & St. Joseph, and other railroads, after a full conference with an authorized committee representing the corporation known as the St. Louis & Keokuk Railroad Company, has agreed to build the road last named on the chartered route from St. Charles to Hannibal, via Louisiana; and the Hannibal & St. Joseph Railroad is to connect with it at or near New London, by a branch from Monroe City, the whole track to be finished and in running order within the present year. This would leave a gap from St. Charles to this city, which it is proposed to fill up by building an independent line, or, in the event of that failing, making an arrangement with the North Missouri road to use the track of the latter from the other side of St. Charles Street Bridge to this city. It is understood that the object of this movement is to form a continuous line from St. Louis to Omaha, under one management. It is reported that the North Missouri Company proposes, by double tracking, to afford the new road an opportunity to come into the city over that route, on favorable terms; but it seems Mr. Joy prefers an independent line into St. Louis from St. Charles, and will construct one on a new route, if sufficiently encouraged by subscriptions along the line to insure the right of way. In whatever manner this part of the project may be arranged, it is a fixed fact that we are to have an all-rail route from St. Louis to Louisiana, New London, Monroe City, Hannibal, etc., before the beginning of the year 1872.—*St. Louis Republican*.

Atlantic & Pacific of South America.

The London *Times* says that, under a commission from the Argentine Government, Messrs. Waring Brothers are sending out a staff of engineers to survey a railroad route of about 1,200 miles from Buenos Ayres across the Andes, to join the Chilean system from Santiago to Valparaiso, thus connecting in the southern hemisphere the Atlantic and the Pacific.

United Companies of New Jersey.

Ashbel Welch, President of the "United Companies" of New Jersey, has issued to the officers and employees thereof the following order:

"A negotiation is pending for the lease of our works to the Pennsylvania Railroad Company. Should suitable terms be offered by that company our Board of Directors will undoubtedly submit them to the stockholders for acceptance or rejection. This is a question for the stockholders themselves, and not for their agents. No official interference one way or the other can, therefore, be allowed."

It is said that the Erie Company is working to prevent this lease, but doubtless the stockholders will be more affected by the terms offered than by any outside pressure. So far, it is said that the terms offered are higher than the Pennsylvania Company can accept.

Boston & Lowell.

The Boston *Advertiser* says: From the city of Lowell—twenty-six miles distant—throughout its entire length to the end of the quay in Boston harbor—this road crosses only four public streets, or highways, at grade. A new passenger station will be built this season by this company on Causeway street, two hundred feet in width and eight hundred feet in length, and at a probable expense of three-quarters of a million of dollars. Near this station the lighter miscellaneous

freight business will continue to be accommodated as heretofore, while the more bulky freight, such as ice, coal, lumber, grain to be stored in elevators for home distribution or foreign shipment, will be carried to the quays, where the largest sea-going steamships in large numbers can have plenty of dock room, and sufficient depth of water to lie safely afloat at low water.

Madisonville & Shawneetown.

This road is important, as affording a connection between existing roads so as to form short routes between Nashville and Chicago and Nashville and St. Louis. A Madisonville paper says that a small force is employed in grading the line, and that it is expected that the track will be laid from Madisonville west to Providence, Ky., about 20 miles, by the end of this year. The distance thence to Shawneetown is about 30 miles.

Paris & Decatur.

Major E. O. Smith, of Decatur, says that he has information which leads him to believe that the Indianapolis & St. Louis Company intend to secure the construction of this road as a branch of their main line. Paris is 66 miles east and 16 miles south of Decatur, and the proposed road will be a little more than 70 miles long.

Southern Minnesota.

The gross earnings for 1870 were \$126,772.67; running expenses for the year 1870 were \$240,105.48; net earnings for 1870 were \$27,677.16. The cost per mile of maintaining way and structure for the year 1870 was \$423.80. There is no discrimination made for or against individuals or localities. There are no elevators on the line. Passenger tariff is five cents per mile. The company has received deeds for 178,442.28 acres of government lands, and 32,242.44 acres of swamp lands, making a total of 210,784.72 acres. The number of acres sold is 23,313.01, for \$163,978.47.

Laclede & Fort Scott.

Mr. John Runk, Chief Engineer of the company, states that there are "eighty-one miles of the line under contract and 70 miles located.

"Work is progressing between Lebanon and Bolivar, in Polk County, a distance of 50 miles.

"From Lebanon to Buffalo, 58½ miles of the grading is at least one-half completed.

"From Buffalo to Bolivar, 20½ miles, the work was but quite recently commenced.

"By authority granted in the charter, the directors have declared an extension of the road from Lebanon eastward, passing through the counties of Pulaski, Phelps, Dent, Iron, St. Francois and Ste. Genevieve, striking the Mississippi River at or near the town of Ste. Genevieve.

"The length of the proposed extension from Lebanon to Ste. Genevieve is 152 miles, making the length of the road from Fort Scott to Ste. Genevieve 280 miles."

Champaign, Monticello & Decatur.

Frank Tiernan and Jesse Burt have taken a contract to complete the grading and to bridge, tie and iron this railroad, and have it ready for use between Champaign and Monticello by July 4, 1871; between Monticello and Decatur, by December 1, 1871; and from Champaign to a junction with the Chicago, Danville & Vincennes Railroad, 40 miles northwest of Champaign, by December 1, 1872. The grading between Champaign and Decatur has been substantially completed for a long time. This part of the line is nowhere more than eleven miles from the Toledo, Wabash & Western road and it, with a section of the Indianapolis, Bloomington & Western road, between Champaign and Danville, which is still nearer, must greatly limit local traffic from the north on the Wabash road between Decatur and Danville, 73 miles, while it will cut off business from the south to those roads.

St. Paul & Sioux City.

The business during 1870, was:

Gross earnings.....	\$367,842 67
Gross expenses.....	197,721 33
Net earnings.....	\$170,221 34
Cost of repairs.....	98,805 56

The lands deeded to this company for constructed road, 697,704 89-100 acres. A large part is remote from settlements, and contiguous to United States land. In 1870 the company offered to sell at \$2.75 per acre. There have been sold to date 97,494.99 acres, at an average of \$5.67 per acre.

Received for sales.....	\$552,936 50
Paid down.....	178,017 91
Credit from 1 to 7 years at 7 per cent.....	379,907 81
Received on installments since sales.....	73,734 89
Expenses of Land Department.....	63,821 49

All net receipts from lands have been expended in construction.

Mobile & Alabama Grand Trunk.

The track is now laying on the first 20-mile section of this road from Mobile northward, and it is probable this section will be finished this month. The Mobile Register learns that the 130 miles more, to Marion, is to

be put under contract at once, to be finished in one year.

Burlington, Cedar Rapids & Minnesota.

The company has received authority from the Minnesota Legislature to extend its road into that State, with the following provisions:

1st. Compelling the road to cross the State line in Faribault County.

2d. Subjecting the road to a tax of three per cent. on the gross earnings of that portion of the line in the State.

3d. Compelling the road to cross the St. Paul & Pacific road at a point in or west of Meeker County.

4th. Prohibiting the company from discriminating between the *prorata* business of such roads as it may cross.

The contract for grading, bridging and tying the road has been let to Messrs. Dows & Co., of Cedar Rapids.

Hastings & Dakota.

The company advertises that proposals will be received at the company's office in Hastings, Minn., until the evening of the 11th of April, for grading, masonry and bridging (except the bridge over the Minnesota River at Chaskee), of an extension of its railroad from its present terminus in Scott County, northwestward twenty miles, to a point at or near the village of Carver, on the Minnesota River, in Carver County. Profiles and specifications can be seen at the office of the Chief Engineer, A. B. Rogers, in Minneapolis. The award will be made on the 12th of April.

The Cincinnati Tunnel.

It is reported that the Pennsylvania Railroad Company is considering the propriety of finishing the tunnel partially made in Cincinnati years ago, in order to accommodate itself by the change in the bridge made necessary by act of Congress.

Burlington & Southwestern.

The Burlington *Hawkeye* says the contract for construction of forty miles of the road, from Farmington to Bloomfield, "has been let to Mr. J. W. Barnes, a well-known citizen of this county, one of the directors of the Burlington, Cedar Rapids & Minnesota Railroad, and a successful contractor on that route. By the terms of his present contract the work is to be finished inside of six months. Bloomfield is eighty-five miles from Burlington. From Bloomfield to Moulton, fifteen miles, the Southwestern will occupy the track, already constructed, of the North Missouri, jointly with that company."

Portland & Ogdensburg.

This line, which was originally intended to connect Portland with the great lakes, and obtain a share of the through traffic between the West and the Atlantic coast, is, according to a correspondent of the Boston *Advertiser*, likely to be a failure as a through route. It has a considerable part of its line in Maine in operation and the rest provided for, but scarcely anything more than the surveys has been done in New Hampshire, and in Vermont, where the road bed has been provided for by local subscriptions, it has the strong opposition of the powerful Vermont Central Company, while it is likely to lose the support of its most powerful friend, Mr. Horace Fairbanks, of the scale works at St. Johnsbury, who, it is said, will be made President of the Passumpsic River Railroad Company, which has intimate and harmonious relations with the Vermont Central. Moreover, the lease of the Ogdensburg & Lake Champlain road by the Vermont Central cuts off the Portland road from its connection with the lakes. It is now proposed to construct it with a connection to or towards Burlington, instead of Swanton, as was originally proposed,—that is if it is built at all. In Vermont it is known as the Lamoille Valley Railroad.

Maine Central.

The company are about to put three new iron bridges on their line. The Kellogg Bridge Company is building them.

Androscoggin Valley.

The directors met at Lewistown, Me., last week, and accepted the proposed route for this road as surveyed by Mr. John Read. It begins in Lewistown, near Androscoggin depot, crosses the river near the Continental Mills and the Maine Central near Elm street, Auburn. It runs through Perryville and East Auburn, where it may deflect again to the left and pass through North Auburn to a point near Turner Village, direct to North Turner and Brittan's Mills, Livermore. From Livermore its course is to Canton Village, Peru, Dixfield and Rumford Falls. The last part of the route, particularly, will be subject to important modifications hereafter. Messrs. A. D. Lockwood, of Lewistown; Israel Washburn, Jr., of Portland, and John W. Perkins, of Auburn were appointed a committee to confer with the directors of the Maine Central, and also the directors of

the Androscoggin road, with reference to a connection with and lease to one or the other of these roads.

Minneapolis & St. Louis.

About two miles of grading remains to be done on the section of this road between Minneapolis and Carver, about 25 miles.

Lake Superior & Mississippi.

Mr. Banning, late the President of this company, has, it is said, promised the people of Taylor's Falls that a branch shall be constructed to that town if they will pay half the engineering expenses and provide the right of way and depot grounds in Taylor's Falls. The place is 25 miles north of Stillwater and fifteen miles east of the line of the railroad.

St. Paul & Sioux City.

The Mankato, Minn., *Union* of the 10th says: "That portion of the Sioux City Railroad west of St. James is owned and controlled by a separate and distinct organization from that owning the road from St. Paul to St. James, and is known as the Sioux City & St. Paul Railroad Company. A prominent New York capitalist, named Mr. Brown, has recently been interested in the road, and has agreed to furnish \$3,000,000 to be applied to the building of the road. Ties have been purchased for about sixty miles of this end, we understand that a heavy force will be put to work as soon as the weather will permit, and that number of miles completed this year. In addition, thirty miles on the Sioux City end are to be graded this year, and the gap remaining will be completed by the 1st of July, 1872. At Sioux City this road connects with a branch of the Union Pacific, giving Minnesota a direct connection with the Pacific coast."

St. Paul, Stillwater & Taylor's Falls.

Nine hundred shares of stock have been subscribed for, and engineers are to locate the line between St. Paul & Stillwater immediately.

MECHANICS AND ENGINEERING.

The Creamer Brake at New Hamburg.

At a session of a committee of the New York Legislature last week to continue the investigation of the New Hamburg railroad disaster, a letter was read from Mr. Creamer, inventor of the patent brakes which were on the express-train, describing the purpose and manner of using the brakes. He says it is the duty of the engineer to pull in the bell cord till taut, and he should not, as in this case, according to the testimony, call on the fireman to do so. He also says his brakes have been in use thirteen years, and never before had it ever been said that they failed. Also, if properly used, a train can be stopped in 800 or 900 feet. This letter, which was written from LaSalle, Ill., by Creamer, stating that it was impossible for him to be present, was put in as evidence.

Cleaning Track by Steam.

A proposal to clean tracks by means of jets of steam before or behind the drivers having been advanced lately as something new, a correspondent of the *American Artisan* says:

"I would like to say that the expedient is an old one. It was in use at least six years ago on the island of Cuba, by an American locomotive engineer, Samuel Sperry. During the rainy season of that tropical region there occurs upon the rails a dense, green, vegetable deposit of very rapid growth; this, with the heavy dews there prevalent, causes frequent loss of time and power, especially on up-grades, from slipping wheels and stoppage of trains. To remedy this Mr. Sperry ran a small pipe, with two branches, to conduct the steam upon the track, immediately before both forward wheels. The device was completely successful, and worked well until the "conservative" tendencies of the Spanish officials interfered to prevent its continued adoption."

We believe that a similar plan has been tried in this country, and that "conservative tendencies" have not altogether approved of it; for, though it cleaned the track very handsomely, it cost more steam than "conservative" engineers were willing to afford.

ELECTIONS AND APPOINTMENTS.

—John B. Calhoun, long Land Commissioner of the Illinois Central Company, has resigned. The duties of the office are performed for the present by Alderman Peter Daggy, who has been in the land office for fifteen years.

—Capt. Peter Berkey has been chosen President of the St. Paul, Stillwater & Taylor's Falls Railroad, in place of R. Blakely, resigned.

—O. F. Moore, Superintendent of the Indianapolis, Cincinnati & Lafayette Railroad, has resigned.

—General M. Jeff. Thompson, who distinguished himself as a partisan soldier in the late war, has received

the appointment of Chief Engineer of the State of Louisiana. General Thompson has for a long time held the position of Chief Engineer of the District of New Orleans.

—A telegram from St. Louis says that A. A. Talmadge, Superintendent of the Indianapolis & St. Louis Railroad, has tendered his resignation, to take effect May 1, and that he has accepted an appointment as General Superintendent of the Missouri Pacific Railroad.

—At a meeting of the Central Railroad Company (A. T. Stewart's) of Long Island, held on the 4th inst., Conrad Poppenhusen was elected President; Loomis White, Vice-President; John A. Locke, Secretary, and Herman Poppenhusen, Treasurer.

—Marvin Hughitt, late General Superintendent of the Illinois Central Railroad Company, has been appointed Assistant General Manager of the Milwaukee & St. Paul Railway. This is quite a marked transfer of allegiance, as the Illinois Central and the St. Paul have not been altogether harmonious.

—At the annual meeting of the Sabula, Ackley & Dakota Railroad Company, the following were chosen directors: Alexander Mitchell, Russell Sage, S. S. Merrill, P. C. Cottrell, R. D. Stephens, George Wells, Hans Crocker, I. M. Preston, John L. Mitchell, M. M. Burns, H. P. Elliott, Alexander Runyon, Geo. Saum, John Plankinton and John W. Cary. The following officers were chosen: President, R. D. Stephens; Vice President, Geo. Wells; Treasurer, H. P. Elliott; Secretary, W. Rathbun; Assistant Secretary and Transfer Agent, Langsdale Boardman; Attorney, I. M. Preston.

—At the annual meeting of the stockholders of the New Orleans, Mobile & Chattanooga Railroad Company, held at the office of the company, in New York, on the 15th instant, the following gentlemen were elected to serve as directors for the ensuing year: Jas. A. Raynor, Wm. S. Williams, E. D. Morgan, J. A. Griswold, Oakes Ames, Thos. W. Pierce, Peter Butler, Geo. Inness, Wm. M. Tweed, Jas. H. Barker, Harrison Durkee, John Stewart, Louis A. Von Hoffmann, Levi H. Morton and Joseph Selegman. At a meeting of the directors for the election of officers, James A. Raynor was elected President; John A. Griswold, Vice-President; Harrison Durkee, Treasurer, and J. J. Howell, Secretary. The Executive Committee elected to serve the ensuing year, and to whom is confided the management of the affairs of the company, are: E. D. Morgan, James H. Barker, Harrison Durkee, John Stewart, L. P. Morton, John A. Griswold and Wm. S. Williams.

TRAFFIC AND EARNINGS.

—The traffic receipts of the Grand Trunk of Canada, for the week ending February 18, amounted to £31,500, against £25,100 in the corresponding week of last year, showing an increase of £6,400, or 25 per cent.

—The traffic receipts of the Great Western of Canada, for the week ending February 17, amounted to £17,867, against £16,095 in the corresponding week of last year, showing an increase of £1,772, or 11 per cent.

PERSONAL.

—One of the victims of the East St. Louis tornado was Mr. John Bodkin O'Neil, Purchasing Agent of the St. Louis & Southeastern Railway. Mr. George Schone, Master Mechanic of the Chicago & Alton shops at East St. Louis was seriously injured.

—Col. Geo. A. Merrill has resigned his position as Superintendent of the Rutland Division of the Vermont Central Railroad.

REGISTER OF EARNINGS.

FOR THE FIRST WEEK IN MARCH.

Michigan Central (284 miles), 1871.....	\$90,866 25
" " (284 miles), 1870.....	\$1,129 77
Increase (12 per cent.).....	\$9,736 48
Earnings from all sources.....	\$100,348 16
Chicago & Alton (431 miles), 1870.....	\$83,223 26
" " (511 miles), 1871.....	74,319 89
Decrease (10½ per cent.).....	\$8,903 37

—The St. Louis *Republican* estimates the losses by the tornado at East St. Louis as follows: East St. Louis elevator, \$15,000; Indianapolis & St. Louis Railroad, \$8,000; Vandalia Railroad, \$75,000; Wiggins Ferry Company, \$5,000; Chicago & Alton Railroad \$350,000; Ohio & Mississippi, \$300,000; Toledo, Wabash & Western, \$200,000; Illinois & St. Louis Bridge, \$15,000, or \$20,000. On the other hand, a telegram dated the 9th inst. says that these figures are much exaggerated and gives the losses as follows: Elevator, \$15,000; Ferry Company, \$10,000; Vandalia road, between \$30,000 and \$40,000; St. Louis & Southeastern, \$15,000; Chicago & Alton, \$50,000; Ohio & Mississippi, \$50,000; Toledo, Wabash & Western, between \$75,000 and \$100,000.

Chicago Railroad News.

Illinois Central.

The following description of this company's new transfer boat "Illinois," which is hereafter to make trips between Cairo and Columbus, to connect the Illinois Central and the Mobile & Ohio, is given in the Cincinnati *Commercial* of the 10th instant:

"Her model is, aft, that of a rounded water-line, while forward she is somewhat hollowed out, the better to adapt her for speedy light work. Yesterday afternoon the trial trip was made, and was eminently satisfactory, giving unmistakable evidence that the trim-looking boat will be unusually fast. The dimensions are: length, 220 feet; beam, 35 feet; depth of hold, 6 feet. The distance from main to boiler deck is twelve feet eight inches, and from boiler to hurricane roof 8 feet. Six large double state-rooms, carpeted with fine Brussels, and furnished with homelike cottage furniture, open with two doors into the ladies' cabin. Forward of the saloon cabin are the mail room, post-office, barber shop, and other conveniences. The cabin is also elegantly furnished with Brussels carpet, center-table, large mirror, sofas, easy chairs, and at night will be illuminated by seven chandeliers. Everything that art can suggest and money procure to contribute to the comfort and pleasure of the trip, has been lavishly provided. The dining-room equipment is on a corresponding style of elegant comfort; all the appurtenances for the furnishing of first-class tables having been provided under the supervision of the company's steward. Silver plate is the leading characteristic of the table ware, the minor articles being of white granite. The railroad company have not let the contract for the provisioning of their patrons, preferring to reserve that duty and perform it well. Ascending to the Texas, it was found to be sixty feet long, and contains twelve rooms, afterwards to be increased to eighteen, for the officers and crew of the boat. Surmounting the Texas is the handsome twelve feet square pilot-house. The two chimneys have an altitude of fifty-two feet six inches above the roof. The machinery of the boat is all of Cincinnati, manufactured by C. T. Dumont, and has been put up under the direct supervision of the company's engineer, who is to run the boat. Five boilers, (one more than is ordinarily placed in boats of this size) thirty-seven inches in diameter, each containing two thirteen-inch flues, will generate the propelling power. The cylinders of the engines are twenty-two inches in diameter, and have seven feet stroke. A noticeable specialty is in the seven-inch receiving valves and the eight-inch exhaust valve. The wheels have a diameter of twenty-five feet, thirteen feet length of buckle, has seventeen arms in a flange, and is supplied with an extra connection of hose on the boiler deck, which will always be attached.

Wisconsin Central.

Messrs. Phillips & Colby, contractors, whose advertisement asking for proposals for building the road was published in the RAILROAD GAZETTE several weeks ago, have let the contract for grading the 64 miles from Menasha, at the north end of Lake Winnebago, to Stevens' Point, to Mr. R. M. Scott, of Menasha. The American Bridge Company, of this city, will build all the bridges on this portion of the line, including one swing-bridge of 240 feet over the Wolf River. The road-bed is to be so far completed that track-laying may begin by the first of July.

Personal.

We regret to announce the death of Edward L. Cleland, Ticket Agent of the Indianapolis, Bloomington & Western Railway in Peoria, and a son of W. C. Cleland, General Western Passenger Agent of the Pittsburgh, Fort Wayne & Chicago Railway. Mr. Cleland was a very promising and popular young man, and his death will be widely regretted.

Freight Rates.

A reduction of one-third in the rates on first-class westward-bound freight from New York and Philadelphia was announced to take effect last Monday. A considerable reduction in the tariff on the other classes of freight was made at the same time. The present rates are, from New York to Chicago: 1st class, \$1.00; 2d class, 90c.; 3d class, 70c.; 4th class, 55c.; special, 45c. From Philadelphia to Chicago: 1st class, 90c.; 2d class, 82c.; 3d class, 65c.; 4th class, 52c.; special, 42c.

Chicago & Alton.

The condition of the country roads, which is fearful, prevents any considerable shipments into the city on this as on other roads. This will account for the considerable decrease of earnings for the first week of this month, which is nearly 11 per cent, and amounts to \$8,900.

The effect of the East St. Louis tornado on the company's property at that place was described pretty accurately last week, but the amount of damage was ridiculously exaggerated. The St. Louis report gave it at half a million of dollars. Reports coming from St. Louis afterwards gradually reduced that amount to \$250,000; but the Superintendent, who was on the ground, at once decided that the loss would not be more than \$30,000, and now it is finally ascertained that \$20,000 will fully cover the loss.

We give elsewhere the company's annual report, which is of unusual interest.

Railway Employees Mutual Benefit Association of the West.

The first annual meeting of this Association was held in this city on the 14th inst. The following delegates were present:

J. W. Bedford, Missouri Pacific; J. A. Spalding, Burlington & Missouri River; B. O. Carr, Central Pacific; O. Kenyon, Buffalo Division Lake Shore & Michigan Southern; G. L. Bertrand, North Missouri; A. W. Adams, North Division Chicago & Alton; N. A. Foss, Chicago, Rock Island & Pacific; George Hancock, Michigan Central; E. M. Whitlock, Cleveland & Pittsburgh; M. M. Towner, Iowa Division Chicago & Northwestern; J. C. Hatch, Chicago & Northwestern;

G. R. Owen, Great Western Dispatch; C. H. Fulton, Empire Transportation Company; S. Athy, Kansas City, St. Joseph & Council Bluffs; J. Hulaniski, Chicago Burlington & Quincy; J. T. Clark, Chicago, Burlington & Quincy; J. W. Bedford, Missouri, Kansas & Texas; M. L. Fouts, Cleveland, Columbus, Cincinnati & Indianapolis, and Erie; Avery Moore, Central of Iowa; D. R. Riddell, Lake Shore & Michigan Southern.

The President of the Association, Mr. A. D. Reid, local freight agent of the Chicago & Alton Railroad, occupied the chair, and William T. Lindley, cashier of the local freight office of the Chicago, Rock Island & Pacific Railroad, acted as Secretary.

By the report of the Secretary it appeared that 917 certificates of membership had been issued during the year, that one certificate had been canceled, and that one member had died, leaving 915 members at the present time.

The accounts of the association were reported as follows:

Collected from mortality fund.....	\$917 00
Collected from initiation fees.....	917 00
Current expenses.....	863 94
From assessments, March 14, 1871.....	915 00
Surplus over expenses.....	988 00

A motion to change the constitution so that one-half of the amount of insurance should be paid to a member in case of total disability, and the balance at his death, was voted down.

The report of the Executive Committee was accepted and adopted.

A. D. Reid was re-elected President, and R. M. Hill Vice-President of the Association.

The constitution was so amended that the officers should be thereafter, a President, Vice-President, Secretary, Treasurer, and Board of Directors of eleven members.

The following were chosen as members of the Board of Directors: W. S. Powell, Charles W. Maybury, C. C. Rising, D. R. Riddell, C. E. Gillett, C. W. Smith, G. L. Bertrand, T. C. Hatch, J. W. Jennings, B. F. Whitman, W. S. Thorn.

The Association adjourned to meet in Chicago on the second Tuesday of March, 1872.

After the adjournment of the Association, the Board of Directors met and chose officers, as follows:

Chairman—W. S. Powell.

Treasurer—A. T. Hall, Treasurer of Chicago, Burlington & Quincy Railroad.

Secretary—W. T. Lindley, Cashier of Chicago, Rock Island & Pacific Railroad.

Spring Meeting of the General Ticket Agents' Association.

Mr. Samuel Powell, the Secretary of the Association, has issued the following circular:

"The regular annual meeting of the General Ticket Agents' Association will be held in the Masonic Hall, Savannah, Ga. on Wednesday, March 29, 1871, at 11 a. m.

"The Pulaski and Screven are first-class hotels.

"The following roads have notified the Secretary by letter that delegates will be passed free over their roads on the proper credentials of their respective companies:

Orange, Alexandria & Manassas.....by J. M. Broadus, G. T. A.
 *Richmond, Fredericksburg & Potomac.....by J. B. Gentry, Auditor.
 *Petersburg.....by D. R. Dunn, Auditor.
 Charlotte, Columbia & Augusta.....by J. M. Selkirk, Sup't.
 Northeastern.....by S. S. Solomons, Sup't.
 *Savannah & Charleston.....by C. S. Gadsden, Eng. and Sup't.
 South Carolina.....by S. B. Pickens, G. T. A.
 *Macon & Brunswick.....by Wm. MacRae, Gen'l. Sup't.
 Wilmington, Columbia & Augusta.....by John L. Pool, Sup't's Cl'k.
 New Orleans, Mobile & Chattanooga.....by G. G. Sanborn, G. T. A.
 Southwestern.....by Virgil Powers, Eng. and Sup't.
 South & North Alabama.....by A. Shaw, Sup't Trans.
 *Nashville & Chattanooga.....by W. L. Danley, G. T. A.
 Selma & Meridian.....by R. S. Steadman, G. T. A.
 Raleigh & Gaston.....by W. J. Hawkins, Pres't.
 Richmond, Danville & Piedmont.....by John MacMurdo, G. T. A.
 *Atlantic & Gulf.....by C. D. Owens, Gen'l Agent.
 *Macon & Western.....by F. W. Clark, G. T. A.
 *Western & Atlantic.....by B. W. Wrenn, G. T. A.

*Wives and ladies included.

The members of the Association, we learn, are expected to make an excursion southward from Savannah into Florida, and up the St. John River, a most attractive journey.

—The very valuable and most beautifully situated country seat of Wm. George Tiffany, Esq., known as "Montebello," lying on the west side of the Harford road, commencing at the homestead, running along the line of the Hillen road for two miles, and containing 371 acres, with some improvements, has been purchased by John W. Garrett, Esq., President of the Baltimore & Ohio Railroad Company, for \$200,000 in gold coin of the United States, \$50,000 in cash, the credit payments in 12 and 18 months, bearing interest in gold. The property purchased occupies one of the highest points, and possesses one of the most beautiful inland and water views in Baltimore County. This purchase, adjoining the estate owned by him before, gives Mr. Garrett about 500 acres of most valuable property in Baltimore County, with a frontage of about three miles on the Harford and Hillen roads. The improvement of the Hillen road, and of the newly laid out Arlington avenue, on which the estate borders, opposite the lands of A. S. Abell, Enoch Pratt, Wm. T. Walters and Wm. P. Preston, Esqs., and the building of the proposed narrow-gauge railroad from Baltimore to Towson town, passing in the rear of these lands, will make the property one of the most valuable in the State of Maryland. In beauty and healthfulness of location it is unsurpassed by any other country seat in the country. —*Baltimore Sun.*



PUBLISHED EVERY SATURDAY.

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Editorial Announcements.

Correspondence.—We cordially invite the co-operation of the Railroad Public in affording us the material for a thorough and worthy Railroad paper. Railroad news, annual reports, notices of appointments, resignations, etc., and information concerning improvements will be gratefully received. We make it our business to inform the public concerning the progress of new lines, and are always glad to receive news of them.

Inventions.—Those who wish to make their inventions known to railroad men can have them fully described in the RAILROAD GAZETTE, if not previously published, FREE OF CHARGE. They are invited to send us drawings or models and specifications. When engravings are necessary the inventor is expected to furnish his own engravings or to pay for them.

Engineering and Mechanics.—Mr. M. N. Forney, Mechanical Engineer, whose office is at Room 7, No. 72 Broadway, New York, has been engaged as Associate Editor of this journal in charge of these departments. He is also authorized to act as our agent.

Articles.—We desire articles relating to railroads, and, if acceptable, will pay liberally for them. Articles concerning railroad management, engineering, rolling stock and machinery, by men practically acquainted with these subjects, are especially desired.

Removal.—The office of the RAILROAD GAZETTE is removed to Nos. 110 and 112 Madison Street.

Our Prospectus and Business Notices will be found on the last page.

THE EDUCATION OF ENGINEERS.

This subject is now receiving a good deal of consideration, both in this country and in Europe. Engineering has assumed such an importance as an element of modern progress and civilization that it has given birth to a new profession whose scope and functions, it is true, are not yet very clearly defined. The amount of capital invested in engineering works in this country, and especially in railroads, can now be counted only by hundreds of millions of dollars. That the disbursements of such amounts of money and the care of property of such value should be intrusted to persons who have never been specially educated in their profession, or, at least, only partially trained for it, begins to excite surprise, and the evil to assume the form of a problem for solution.

The exact nature, or, as the doctors say, the diagnosis of it, is not the easiest element in determining what should be done. That many engineers—we use the term very broadly—are ignorant of many things which they should know, and lack qualifications they should possess, we all know very well; and therefore we propose to consider 1st, what should engineers who are employed on railroads know, and what qualifications ought they to possess? and 2d, how can they acquire the knowledge and get the training which they need?

At the very outset of the consideration of these questions, we are met by the old contention of the relative merits of *theory* and *practice*. The practical men who have no theoretical knowledge scoff at the theorists, and the latter sneer at the attainments of those who bear the burden and heat of the day. It requires very little experience on the one hand, and not much study on the other, to learn that each are equal-

ly important, but in different ways. A very common error prevails with reference to the value of education, as the term is popularly used. It is not so much the acquisition of any positive kind or quantity of knowledge, as it is the development of the faculties which enable us to learn. It is, to a great extent, like the exercise of the gymnast, the value of which is not in any useful purpose directly accomplished, but in the strength and flexibility which the practice gives to the muscles. This is the case when a child begins to learn its letters. Its attention is fixed upon their mere form, which gradually becomes associated with their names. The impression, however, is received through a series of voluntary efforts to acquire the knowledge. The combination of letters into words requires a still further effort of this kind, and gradually the faculties are strengthened and accustom themselves to receive knowledge in this way. Education implies a constant subordination, or submission, of the faculties to the reception of knowledge, and the practice of receiving new ideas from books gives a sort of mental dexterity and facility of comprehension which the people who do not read or study seldom learn. Persons who learn only by experience and observation must have new ideas presented in some material form before they thoroughly understand them.

Words seem to carry no very distinct or clear image to their minds. The tendency of this, especially on those who are naturally intelligent and observant, but whose range of thought is limited by their own experience, is to make them, to a certain extent, oblivious of the existence of any other knowledge excepting that which has revealed itself to them; and if such people occupy positions in which they are in the constant habit of exercising authority, their minds are very apt to become narrowed down into the limits of their own range of thought, to become intolerant of other people's opinions, and to assume that all knowledge and knowing begins and ends with what they have learned. A person who is in the habit of having his word regarded as law, and whose opinions and wishes are seldom questioned, is very prone to over-estimate his own capacity, unless he is in the habit of often measuring and comparing his ideas, by study or reading, with those of others. It will therefore often be found that the most intelligent, uneducated people—those who don't believe in "theory"—are the most intolerant of others' opinions, the most arrogant in asserting their own, and the slowest to learn what others could teach them. This type of man, we regret to say, can be found among the master mechanics, car builders, etc., on our railroads. There is not much danger of our hurting their feelings, because such as we refer to will not read this or anything else. The assertion will often be heard from them that "they do not like" this or that, as though their likes and dislikes were the standard of all truth. Argument with them has no influence, and a demonstration as clear as mathematics is like water on a duck's back.

One of the most marked effects of education is the fact that it extends the intellectual vision, liberalizes the mind, and gives a wider range and greater comprehension to our thoughts. Study gives a quickness of apprehension which enables a person to profit by all the experience of others which is recorded in books. It develops a power of appreciation and concentration, enforces exactness and accuracy, and, if properly directed, teaches how to classify facts, make deductions and reason logically, and, "when carried far enough, gives that luminous power of invention without which it is impossible to penetrate into the secrets of nature."

We do not intend to say that the kind of training which we have tried to describe can only be received in schools and colleges. Many self-educated men have acquired it through their own exertions, and the aspiring young engineer who is debarred from the advantages of a thorough scholastic education need have no cause for despondency. If we were to say that a person dependent upon his own exertions, and with little time for study, had as easy a road to travel as he who has all the advantages which experience teaches and ample time can give, we should be saying what is not true. But because we have a rough journey is no reason for sitting down in despondency by the roadside. The extra exertion and effort required will give an advantage of their own, which the easier work of a school will not develop.

We have no intention of undervaluing the importance of practical experience. Upon the contrary, of the two, the knowledge gained in the actual practice of his profession is to the engineer and those who employ him of very much the more value; but what we desire to impress is the fact that the intellectual training which a man gets from the study of books is of inestimable advantage to an engineer, and that without

it he never can be thoroughly qualified for his profession. Our reason for thinking so is not only or chiefly because without this kind of education he will be lacking in certain definite information which could be acquired from books, but because of the want of that intellectual training without which he is almost sure to be not only narrow-minded, but also very slow in receiving new ideas or estimating the value of old ones. Therefore, in the education of engineers in schools, it is not of the most importance that they should learn such things as they can turn to practical account in their profession, as it is that their minds should be disciplined, and that they may learn *how to learn*. Swedenborg we believe it is who teaches the doctrine that the spiritual vision in the natural state is, as it were, veiled or clouded, and unable to distinguish, excepting vaguely, between good and evil, but that by the constant effort to do good this veil or cloud is removed. We are not discussing theology, therefore have nothing to say with reference to this doctrine, but it represents very well the condition of the mind and the effect of intellectual training. The mind, in its natural state, is also veiled, so that things are not seen distinctly; but the voluntary effort to see through this cloud, like the rays of the rising sun, will pierce through the mist that gathers in the darkness, and soon dissipate the veil and reveal objects distinctly.

It is difficult for any one accustomed to the companionship of books all his life to realize the exceeding slowness with which ideas embodied in print reveal themselves to persons who are not in the habit of reading. The commonest paragraphs in a newspaper will be read over and over again before their meaning is understood. The comprehension of any involved idea will be very slow, and it must be presented in a variety of ways before it impresses itself on such minds.

It may seem strange that it should be at all necessary to say anything about the importance of education as one of the qualifications of an engineer or master mechanic, but there is a sort of dormant idea prevailing which, it is true, is seldom distinctly expressed, to the effect that education is not at all a requisite or useful qualification for persons filling responsible positions in the mechanical and engineering departments of our railroads. The impression seems to prevail that no one can be thoroughly educated without becoming in some sense an unpractical theorist. That well educated men are sometimes visionary, we do not deny, and that practical experience is as necessary to qualify them for the duties of such positions as it is for less cultivated people, is also true; but education combined with the practical knowledge will always make a man a better engineer, master mechanic, or superintendent of cars.

In a future article we will have something to say about the kind of education engineers need and the best way of getting it.

THE UNION PACIFIC.

Mr. Ames, the retiring President of the Union Pacific Company, did not deal much in figures in his report read at the meeting of stockholders last week. He said, however, that the earnings were less than had been anticipated, and attributed this to the great depression of business in California; but for the current year he believes that the net earnings will be sufficient to pay the interest on all the bonds. He says that the road was very much improved during the year by perfecting the road-bed, strengthening snow sheds and increasing snow fences. The latter have been so efficient that during the past winter the trains of the road have never failed to make connections at either end, though the Iowa roads and most Northern roads have been more or less obstructed and their trains delayed. The snow question, we should say, has been pretty effectually settled. The Union Pacific is no more liable to obstruction than most lines in this latitude; though obstruction on that line, doubtless, is not so easily removed as on a busier line and may be more serious than in a well settled country.

The intended abandonment of the company's shops at Wahsatch and Bryan and the erection of substitutes at Evanston is said to be on account of the danger of the old shops from fire and the excellent and plentiful coal near the new ones, which are to be completed in May.

The bridge at Omaha is spoken of as an important addition to the convenience of travel, and it is announced that the company will try to have it completed the coming summer. At the recent session of Congress authority was obtained to mortgage this bridge, and the company now proposes to issue \$2,500,000 of 20 year 8 per cent. bonds to provide means for its completion. This is a pretty large sum to complete a bridge, and the interest, \$200,000, will be a very fair sum for the bridge to earn. It is possible that

the figures which we have copied are a misprint, however. The bridge is needed now, and Nebraska is growing, and a very large portion of the traffic of this State, besides that of the Union Pacific, is likely to cross this bridge for a long time to come.

A great deal of business is anticipated from the opening of new mines in Colorado and Utah, and 10,000 or 15,000 is given as the number of miners likely to go to the new mines near Salt Lake. A mining excitement anywhere on the line is sure to add greatly to the business of the road, for miners are always ready to rush to some new field. If the mines are really valuable, of course a permanent business will be developed; but a temporary excitement will give the road a good business for a time, first, in conveying adventurers to the new El Dorado, and second, in conveying them away again. It is fortunate for the road that the new mines are near Salt Lake, as thus it will have whatever traffic they may make over the whole length of the line.

If there is any increase in mines permanently worked within reach of the road, it will give a business in both directions, as the ores are largely shipped for reduction to the East—often to Wales—and machinery and supplies must go in the other direction. The good and cheap coal at Evanston will doubtless do much for the line in future years, but we cannot very soon expect the manufacture of cheap iron, of which Mr. Ames speaks; something more than good ore and good coal is needed to make cheap iron, even when these minerals are found in juxtaposition, as they are in some parts of the Southern States. Cheap labor, cheap supplies and a steady and large market will not be found very soon at Evanston, though likely enough we may see another Pittsburgh there, if we only wait long enough.

Mr. Ames calls attention to the advantages of the great plains for grazing, furnishing as they do an unlimited range which is not likely for many years to be interrupted by settlements. Still the land sales have been quite as large as could have been expected, 292,900 acres having been sold at an average price of \$4.46 per acre. The sale is reasonably expected to continue this year, and is of the utmost importance to the company, not only because of the income obtained, but also by the local business secured by the settling and cultivation of the country on its line.

An increase in the transportation of freights from China and Japan is expected. This seems to be secured by the arrangement with the Pacific Mail Steamship Company, which will, we understand, hereafter give part of its freight to the railroad at San Francisco, instead of carrying it *via* Panama in its steamers. The Montana business which until last year was carried entirely on the Missouri River, is likely to go almost entirely, hereafter, by the Pacific road to Evanston, Ogden or Corinne, and thence by wagons.

Mr. Ames charges the Treasury Department with hostility on account of its decisions with reference to the payment of interest on its second mortgage bonds, "after we had saved the government millions upon millions on the cost of its transportation over the plains and to the Pacific; after we had done away with the necessity of keeping a cordon of soldiers for 1,800 miles to secure the safety of emigration of trans-continental trade; after we had opened the vast interior to settlement seven years earlier than required of us by our charter."

Now this little gush of sentiment is hardly becoming in the president of a railroad company. The question of the payment of interest was one of law and not of sentiment or good will, and it makes absolutely no difference whether the road has been a benefit or an injury to the nation, so far as this question is concerned, which was, Is or is not the Union Pacific Railroad Company fulfilling its contract? If it was not, it was Secretary Boutwell's bounden duty to make it even if the incidental advantages of the road to the government had saved the whole amount of the subsidy yearly. He thought the company was delinquent, and tried to do his duty. It seems that he was mistaken in his interpretation of the law, but if he is to be blamed it should be for blundering, and not for a lack of appreciation of the manifold blessings of the railroad to the Pacific.

The inaugural address of the new President, Thomas A. Scott, affords some insight into the business and condition of the company. We publish it elsewhere.

This shows that the net earnings of the year were \$2,947,862, while the interest on the bonded debt to be paid from this amount was \$2,831,123. But Mr. Scott estimates that the earnings next year will be \$9,000,000, and the operating expenses \$4,500,000, leaving an equal amount as net earnings, which is 50 per cent. greater than the net earnings of 1871. For this, it will be necessary for the receipts to increase about 20 per cent., and that the proportion of operating expenses be kept down to that of the latter half of 1870,

when it was 52 per cent., while it was 72 per cent. during the first half of the year. It will be a very creditable thing to keep the expenses of the road down to 52 per cent. this year; for, it must be remembered, the road is growing older, and we may naturally expect increased expenditures for renewals of rails and rolling stock; and, moreover, it is easier to make the proportion of expenses low just after it has been high, than after it has been low for six months.

Mr. Scott thinks that the road has done well, thus early in its existence, to earn the interest on its bonds, and we believe he is right. The Union Pacific was built through the wilderness, and it has had to develop a traffic on its line, and divert its through business from long established routes. It has done well to make a beginning, and to become recognized as a trustworthy trans-continental route. Its business must grow continually, not necessarily with great rapidity, but continually and for a long series of years.

THE CHICAGO & ALTON REPORT.

The report of the Chicago & Alton Railroad Company, which we give elsewhere in this number of the GAZETTE, is a document that ought to be altogether satisfactory to the stockholders of this company and put them in excellent humor with the officers who have handled their property so handsomely.

The increase in earnings has not been very large—3½ per cent.—but the earnings were quite satisfactory the previous year. There was an increase of mileage, it is true, but, on the 35 miles purchased in March, traffic has only fairly been developed, and the 45 miles constructed by the company were only opened a few days before the close of the year.

The operating expenses are almost exactly in the same proportion to the earnings as in 1869, the difference being only .51 of one per cent. in favor of 1870. The increase is about \$56,000 in conducting transportation, \$46,000 in maintenance of way, \$12,000 in "general expenses," and no less than \$42,000 in taxes; but on the other hand there is a decrease of \$4,000 in motive power and \$44,000 in maintenance of cars.

There is a decrease of nearly \$100,000 in passenger receipts though there was a trifling increase in the passenger business. The increase in freight earnings is about \$250,000. This is an increase of about 2½ per cent. in receipts, while the increase in business was 12½ per cent.

The new lines of the company are shown to have been acquired at a very low rate, not quite \$14,000 at present and not to exceed \$15,000 per mile when quite completed. So these branches may be quite profitable to the company even if the traffic is quite light, and receipts of \$4,000 or \$5,000 per mile would doubtless be very remunerative, the more so as no considerable addition to rolling stock will be required to work them.

Perhaps the most interesting and important part of the report is that which refers to the lease of the Louisiana & Missouri River Railroad and the company's plans for Kansas and southwestern business. The fact of the lease was long ago made public, but it will surprise most men to know that arrangements have been made to secure a through line to Kansas City long before the completion of the road to that place, and even early in the present season. This is done by a combination with the North Missouri Railroad Company, which might naturally be supposed to be hostile to the new line as a parallel route competing for its business. But the North Missouri managers have been wise enough to recognize the inevitable; and instead of fighting against a line whose construction they could not prevent, they have made such a combination with it that the traffic of both lines is likely to be greatly increased for some time to come, at least, if not permanently.

By this contract, as soon as the Louisiana & Missouri River Railroad is completed to Mexico, 51 miles west of Louisiana, where it will cross the North Missouri Railroad, trains are to be run through between Louisiana and Kansas City, using the track of the North Missouri road west of Mexico. The road-bed is entirely completed between Louisiana and Mexico, and by contract the track is to be laid by the 19th of May next.

The Chicago & Alton's connection with Louisiana is to be completed by July next, and then we may expect the new through line between Chicago and Kansas City to be open. The distance by this route will be 487½ miles, as follows:

Chicago to Roodhouse.....	236	miles.
Roodhouse to Louisiana.....	37	"
Louisiana to Mexico.....	51	"
Mexico to Kansas City.....	163½	"
	487½	miles.

The route by way of Quincy, now the shortest, is 489 miles long; so that the two routes will be almost absolute-

ly equal in length, and the saving over the Chicago & Alton's old route by way of St. Louis will be 65 miles.

There can be no doubt, we should say, that this line will obtain a large share of the great and growing business between Chicago and Kansas. The Texas cattle traffic and the great immigration to Kansas have made this business very large, and to this line it will be a through traffic. So the lease made last year is likely to have immediate returns.

Moreover, a branch of this Louisiana & Missouri River Railroad is to be completed by the 19th of May from Mexico southward 50 miles, to the Missouri River opposite Jefferson City. This branch will have the traffic of a territory ten to fifteen miles wide on each side of it pretty much to itself, and ought to be profitable by itself; but it will be admirably placed to receive connections from the south side of the Missouri River, which are pretty sure to be constructed in course of time, there being plenty of room in South Missouri for new railroads.

Thus, by the 1st of July next, the company is likely to have 138 miles of new road, all with an ample local traffic, and a new and short connection with Kansas City, which is sure to increase very largely by its through business.

The Louisiana & Missouri River Railroad is to be completed to Glasgow, where it will cross the Missouri, by the 19th of May, 1872, and to Kansas City a year later. The rental is to be 35 per cent. of the gross earnings unless the gross earnings should fall below \$4,000 per mile—an improbable contingency. Of this rental \$1,120 will be paid directly for coupons of the first mortgage bonds, which, we believe, are held chiefly by the Chicago & Alton stockholders. There will be an issue of \$10,000 of preferred and \$5,000 of common stock, as well as \$16,000 of bonds, per mile of road. Local subscriptions of about \$11,000 per mile have been made to the common stock, and all these together should be sufficient to put the road into excellent condition and stock it heavily.

Accompanying the report is a large map showing the company's road, the proposed extensions, and the connections. This map shows the country from Chicago to the Gulf and west as far as Denver. This map gives the lines correctly and shows at a glance with the greatest clearness the admirable location of the Chicago & Alton road for southern and southwestern business. The connections at the St. Louis terminus are continually increasing in number, extent and importance, and will soon give the shortest line to Arkansas, as it now has to the Indian Territory. The Missouri, Kansas & Texas Railway, with 350 miles of line in Missouri and Kansas and a line soon to be completed across the Indian Territory, will find its best Chicago connection through this road by a short extension from Sedalia to Glasgow or a point near by. Indeed, it will form the most direct outlet to Chicago, for nearly all of Southwest Missouri and a large part of Kansas and Arkansas, and be a section in a short line to Texas and the Gulf.

Railroad Gauges and War.

M. Gambetta, who was the active minister of the French Provisional Government during the late war, proposed, in a flaming speech, lately, that the gauge of the French railroads should be changed in order that they might not be available for German rolling stock in case of another invasion. It seems that it did not occur to M. Gambetta that in that case German railroads would not be available for French rolling stock—else he must have taken it for granted that France will never attempt to make a campaign east of the Vosges. "It's a poor rule that won't work both ways." But then, perhaps, M. Gambetta has joined the Peace Society.

American Locomotives.

Mr. A. Brunner, who wrote the letter to *Engineering on American Locomotives*, published in the RAILROAD GAZETTE a few weeks ago, is the engineer of the "Societe Cockerell," of Seraing, Belgium, one of the largest engineering establishments in the world, employing about 10,000 men. As Mr. Brunner is the designer of and builder of many locomotives used in Europe, his opinion of American locomotives is especially valuable.

—A fifty thousand pound hammer is being placed in position at the New Albany Steam Forge Works. Under this monster hammer is imbedded eleven thousand feet of timber, and upon the slides is nine thousand feet, making in all twenty thousand feet of heavy oak timber for a foundation.

—It is reported that Mr. Thomas L. Kimball has been appointed General Passenger Agent of the Union Pacific Railroad.

NEW PUBLICATIONS.

The Profession of the Mechanical or Dynamical Engineer.—This is the title of the inaugural address delivered before the Sheffield Scientific School of Yale College, by Prof. Wm. P. Trowbridge, on the occasion of his assuming the chair of Professor of Dynamical Engineering. This address was pretty widely circulated near the time of its delivery last fall, through the press, and we are glad to see it put into a more permanent form. Mr. Henry Carey Baird, the Philadelphia publisher of technical books, has printed it in pamphlet form for gratuitous circulation. Professor Trowbridge is unusually well qualified, both by education and experience, in practice and teaching, to understand this subject. He was educated at West Point, was an officer of the Engineer Corps of our army, distinguished himself on the coast survey, was for a short time a professor in the University of Michigan, was afterwards connected with some scientific bureau in the government service, and for some years was in the service of the Novelty Iron Works, of New York, one of the most extensive manufacturing of machinery in the country. The address sets forth so clearly the importance of scientific training to mechanical engineers that it can hardly fail to impress any young man who designs to qualify himself for that profession.

A few Hints on Landscape Gardening.—This little pamphlet of twenty pages, the authors distinctly inform us, is "an advertisement for gratuitous distribution," but we find it an advertisement of quite as much value to the community as it well can be to the writers. It contains, first, an essay by H. W. S. Cleveland, with the title given above, which ought to be read—and heeded—by every man who owns half an acre of ground. It might, and we believe it would, make all the difference between beauty and hideousness in scores of Western towns, were it read by those who have charge of planning them. The second part is an essay on "The Relation of Engineering to Landscape Gardening," by W. M. R. French. Mr. Cleveland is a landscape architect of this city, of rare taste and ability, and Mr. French, an engineer, is his partner. Their pamphlet is illustrated by two colored lithographic plans, one of private grounds and one of a suburban village, and we can assure all who receive it that it is well worth reading.

OLD AND NEW ROADS.

[Continued from Page 584.]

Portland & Ogdensburg.

A correspondent writing from St. Johnsbury, Vt., says: "The Portland & Ogdensburg Railroad Trunk Line, Western Division, which comprises the Essex County, Montpelier & St. Johnsbury and Lamoille Valley railroads, is being pushed as fast as weather and means will admit. Mr. A. C. Mitchell, Chief Engineer, with several resident engineers, including Mr. Early, who has charge of the Montpelier & St. Johnsbury Railroad, are live men, and are introducing some improvements not found in this section.

"King, Fuller & Co. have the contract for grading 90 miles and Henry Danforth the contract for culverts, etc. The railroad company builds its own bridges and trestles. W. H. Clough has charge.

"This line runs 110 miles through the roughest portion of Vermont and also New Hampshire, running through the White Mountains. Towns through which the road runs have raised money by bonds, the popular method in New England. Cars are running from the Passumpsic River Railroad to Fairbank's Scale Works. The Passumpsic River Railroad is running the trains for the present. The Offices of the company are at St. Johnsbury."

Delaware Railroads.

Bills have been introduced into the Delaware Legislature to charter the following railroads: The Middletown & Elkton Railroad Company to construct a road from Middletown on the Delaware Railroad to Elkton on the Philadelphia, Wilmington & Baltimore. Also, to construct a road from the town of Milford along the bay shore to the city of Wilmington, to be called the Milford & Bay Shore Railroad. The former road is to open a short route from the peninsula to Baltimore.

Iowa Midland.

It is reported that the Chicago & Northwestern Company has offered to furnish the iron and rolling stock for a branch of this road from Maquoketa northwest to Cascade, about 25 miles, if the right of way, grading, bridging and ties are supplied by the local company. If this proposition is accepted, it is thought that the construction of the Iowa & Chicago Railroad, from Bellevue westward to Cascade, will be prevented.

The New Erie Bonds.

Judge Rosekrans, of the New York Supreme Court, has issued a temporary injunction prohibiting the negotiation of the new \$30,000,000 consolidated mortgage bonds of the Erie Railway Company, and ordered the company to show cause why the injunction should not be made perpetual on the 22d inst., at Glen Falls.

—The New York Central & Hudson River Railroad Company has declared a semi-annual dividend on stock and scrip of 4 per cent., payable April 15. This is equivalent to a dividend of 7.2 per cent. on the stock before the last watering.

CHICAGO & ALTON RAILROAD.

Report of Operations for the Year Ending December 31, 1870.

Below we give the eighth annual report of the Directors of the Chicago & Alton Railroad Company, for the year 1870. It is dated February 10, 1871, and signed by the President, Mr. T. B. Blackstone:

The Board of Directors submit the following report of the company's affairs and its operations during the year ending December 31, 1870:

CAPITAL STOCK.	
Common.....	\$8,925,500
Preferred.....	2,426,400
	\$11,351,900
FUNDED DEBT.	
Preferred sinking fund bonds.....	\$300,000
First mortgage bonds.....	2,383,000
Income bonds.....	1,087,000
	\$3,770,000
	\$15,121,900

The following statement will exhibit the gross receipts and expenditures during the year:

EARNINGS.	
From passenger traffic.....	\$1,392,184 93
From freight.....	3,312,067 73
From express companies.....	92,827 18
From transportation of United States mail.....	55,529 63
From miscellaneous sources.....	96,795 42
	\$4,949,404 89
EXPENSES.	
For conducting transportation.....	\$630,977 06
For motive power.....	763,156 04
For maintenance of way.....	862,539 70
For maintenance of cars.....	253,508 89
For general expenses.....	108,926 68
For taxes.....	161,697 46
	\$2,787,105 85

Net earnings.....\$2,162,298 04

The financial statement for the year is as follows:

INCOME.	
Balance at credit of this account, January 1, 1870.....	\$5,430 75
Net receipts as above stated.....	2,063,299 04
	\$2,114,719 79
DISBURSEMENTS.	
Interest on bonds of all classes.....	\$246,930 00
Paid sinking funds.....	60,000 00
Rent of Joliet & Chicago Railroad, exclusive of sinking fund.....	138,049 89
Rent of St. Louis, Jacksonville & Chicago Railroad.....	240,000 00
Dividends paid, Nos. 14 and 15.....	831,645 00
Government tax on dividend and sinking fund.....	21,110 26
Loss by fire in 1865, insurance uncollectable.....	16,554 43
Cost of improvements charged this account.....	226,141 73
	\$1,839,481 31

Balance December 31, 1870.....\$285,238 48

At the commencement of the year 1870 your company was operating four hundred and thirty-one miles of railway, as follows:

Chicago to Joliet, under perpetual lease, executed January 1, 1864.....	38 miles.
Joliet to East St. Louis, owned by your company.....	343 "
Bloomington to Godfrey—St. Louis, Jacksonville & Chicago Railway, under perpetual lease, dated April 30, 1869.....	151 "
Total.....	431 miles.

During the year your company has acquired, by purchase and construction, eighty miles of railway, as follows:

Dwight to Wenona, by purchase at actual cost, March 15, 1870.....	35 miles.
Wenona to Washington, by construction under the direction of the officers of your company, opened December 11, 1870.....	35 miles.
And a branch line from Varna to Lacon, opened December 18, 1870.....	10 miles.
Total.....	80 miles.
Making total number of miles in operation January 1, 1871.....	511 miles.

The cost to your company of the eighty miles of railway acquired, as above stated, will not exceed the estimate of fifteen thousand dollars per mile made at the time the question of its acquisition was submitted to the stockholders for their approval. The present state of that account with the road in operation, but not in all respects fully completed, shows the cost to be \$1,108,747.26, or \$13,859.34 per mile.

It will be seen from what has been stated, that only thirty-five miles were acquired in time to affect the receipts of your company for the year to any considerable degree, and by reason of the almost total failure of the crops in that section of the State in 1869, the traffic was very light.

The country traversed by the lines recently acquired is unsurpassed for fertility. It is all under cultivation, and a large traffic may be expected from the products of the soil. One of the best, most extensive and cheaply mined deposits of coal in the State is located upon this line, from which a traffic has already sprung up, amounting to an average—during the past nine months—of four thousand tons per month.

Your directors are confident that the traffic will pay a liberal return upon the cost of the line.

The operation of the Jacksonville Division during the past year shows in direct returns from traffic, as well as in many other ways, the great advantage of controlling that line under the existing lease.

The operating expenses upon your lines for the year (exclusive of taxes) amount to \$4.11 per cent. of gross receipts; including taxes, 57.4 per cent. In 1869 the operating expenses were 54.62 and 57.17 per cent. respectively.

The number of passengers carried during the year was 732,531, being an increase of only 978 over the preceding year; 94.3 per cent. of the number of passengers were local, only 5.7 passing the entire distance between Chicago and St. Louis. The average amount of fare paid by passengers (including through and local) was one dollar and sixty-two cents.

By reason of the general failure of crops, a decrease in the amount of freight traffic for the year was feared, but we are happy to report that the general increase in industrial pursuits and an increased amount of through traffic with points west of the Mississippi River, have enabled us to show an increase over that of the preceding year.

The aggregate tonnage of freight for the year is 2,522,064,297 lbs., an increase of 12½ per cent. over that of 1869.

The coal traffic of your line continues to increase. Commencing in 1865 with only 6,000 tons, it has increased to 266,096 tons in 1869, and 338,324 tons in 1870, showing an increase of 27 per cent. during the past year.

The receipts from express companies, carriage of mails, and from miscellaneous sources, amounts to \$245,152.23, an increase of \$21,330.58 over the corresponding receipts in 1869.

The condition of your property has been fully maintained,

and in many respects improved. Four thousand seven hundred and sixty tons of new and re-rolled rails, and two hundred and eighteen thousand cross ties were used in repairs and renewal of track, and the cost charged in the account of operating expenses.

Experience has shown that economy requires the use of steel rails on portions of your line which are subjected to the heaviest traffic. We have nine miles of steel track rail now in use, to which it is expected that at least twenty miles will be added during the present year.

Nine new depot building at way stations, and a blacksmith shop, foundry, boiler house, and rolling mill for repairing rails, at Bloomington, have been completed during the year.

Six and one-third miles of new side tracks have been added during the past year.

The number of locomotives owned by your company is one hundred and eight. That they have been kept in good condition for service is not only apparent upon inspection, but is attested by the fact that the average mileage of each engine during the year amounts to 27,469 miles, making an aggregate of 2,966,664 miles.

The cost of motive power per mile run may be stated as follows: repairs, 6.76 cents; wages, 6.61 cents; fuel, 8.35 cents; oil and waste, 0.43 cents; and cleaning, etc., 1.25 cents; making a total of 24.43 cents.

The cost per mile run in 1869 was 28.94 cents, showing a reduction of 4.51 cents.

The traffic of the present year will require an additional number of engines, and measures have been taken to procure the delivery of fifteen at an early day.

The number and description of cars upon your line is as follows:

Pullman's palace sleeping cars.....	8
Pullman's dining cars.....	5
Passenger coaches.....	47
Baggage, mail and express cars.....	21
Freight cars of all kinds.....	2,256
Tool and wrecking cars.....	5
Paymaster's car.....	1
Total.....	2,343

Of the number stated above, five passenger cars, one tool car, and two hundred and eighteen freight cars, have been constructed at the company's shops during the year.

The condition of your cars has been fully maintained.

In anticipation of an increased traffic, freight cars are now being constructed at your shops at the rate of fifteen cars per week.

While your Board of Directors fully appreciate the fact that the policy of your company in the future should be (as it has been in the past) to foster and encourage local traffic, we have also felt it to be our duty to ask permission in writing from the stockholders (as required by our charter) to make such contracts of lease or otherwise as should appear to the board to be expedient to secure a portion of the large and rapidly increasing traffic between Chicago, Missouri, Kansas, and the Southwest. This permission was asked by circular, dated December 15, 1869, and its importance was so apparent that the approval of our stockholders was given almost unanimously.

Negotiations were immediately commenced with the St. Louis, Jacksonville & Chicago Railroad Company for permission to use the franchise of that company in the construction of a line from Roodhouse to Louisiana, in the State of Missouri, a distance of 37 miles, and also with the Louisiana & Missouri River Railroad Company, of Missouri, for the completion and control of their lines in process of construction.

A contract has been concluded with the St. Louis, Jacksonville & Chicago Railroad Company, by which, in consideration of the fact that under the terms of the perpetual lease of that line as now operated by your company, provision is made for a certain increased rental (*pro rata*) when the gross receipts of that line shall exceed certain stipulated amounts, and the prospect that an increased traffic upon that line will result from the execution of our plans, they grant to your company the right to construct the line as above stated, and use the same in all respects as its own property. They also grant the subsequent use of their franchise as may be found necessary in operating the same.

They also agree to issue, for the use of your company in providing a construction fund, \$15,000 per mile of first mortgage bonds, and \$5,000 per mile of second mortgage bonds—if the same shall be required—upon condition that your company shall assume the payment of interest and principal of all bonds so issued at their request. The work of building the road from Roodhouse to a point on the Mississippi River opposite Louisiana, in Missouri, is now in progress, and will be completed by July next.

A contract has also been concluded with the Louisiana & Missouri River Railroad Company, by which the company agrees to complete its road bed, including bridges and crossings, so as to have the same fully prepared for laying the rails from Louisiana to Mexico (a distance of 51 miles) by the 19th day of May, 1871. That company also agreed to complete, in like manner, a line from Mexico to Jefferson City—the capital of the State—a (distance of 50 miles) by the 19th of May next.

It is further agreed that in a like manner a roadway shall be prepared from Mexico to Glasgow by the 19th of May, 1872, and also from Glasgow to Kansas City, upon a location to be agreed upon (with the exception of constructing a bridge over the Missouri River, by the 19th day of May, 1873).

In all the undertakings on the part of that company, as before stated, including the cost of right of way and depot grounds, it is provided that payment shall be by them made from the proceeds of local subscriptions to their common stock—said subscriptions amounting to about \$11,000 per mile for the entire distance.

It is further stipulated that first mortgage 7 per cent. bonds, at the rate of \$16,000 per mile, shall be issued, and that \$15,000 per mile in said bonds, \$10,000 per mile in preferred stock, and \$5,000 per mile in common stock, shall be placed in the hands of a trustee, and appropriated to the purchase of materials, the completion of the road, and procuring rolling stock. And that the sale of said bonds and shares of stock, and the completion of the railway and purchase of rolling stock, as aforesaid, shall be under the direction of the officers of your company.

Your company agrees, on its behalf, to construct a line to connect its present lines with Louisiana, and to take possession of and operate for one thousand years the line from Louisiana to Mexico, and such other extensions of that line as may be hereafter completed, as before stated, and that the amount of rent to be paid for the use of the same shall be yearly ascertained as follows: All taxes and assessments shall be first deducted from gross earnings, and 35 per cent. of the remainder shall be the amount to be paid as rent for that year, provided that the amount paid shall in no year be less than \$1,370 per mile; and that your company shall assume the payment of coupons on the mortgage bonds referred to, and charge the amount of the same on account of rent.

A contract has also been made with the North Missouri Railroad Company dated May 25, 1870, by which it is mutually agreed to operate a through line for passengers and freight

upon equitable terms, between Chicago and other points on the Chicago & Alton road, and Kansas City and other points on the North Missouri and connecting roads, as soon as the connection is made at Mexico. Said contract to continue in force until the Louisiana & Missouri River Railroad shall have been completed to Kansas City—either party having the right to terminate it after the road shall have been completed to that point, by giving three months' notice.

From Louisiana to Mexico the road bed and bridges are now nearly completed, and it is confidently expected that a through line will be in operation between Chicago and Kansas City, via Louisiana and Mexico, by the 1st day of July next. That line will be as short as the most direct line now operated between Chicago and Kansas City. When the proposed line is completed from Mexico to Kansas City the distance will be less than by any other line.

Other connections will be secured in Missouri by building the lines heretofore designated, which will give to your company, and those with which connection will be made, the advantages of a route from 80 to 100 miles shorter than any other built or projected between Chicago, Southern Kansas, the Indian Territory and Texas.

The country which will be traversed by the lines in Missouri will afford a large local traffic, and a large through traffic is confidently expected, especially in transportation of lumber and Texas cattle.

A map is annexed to this report, showing your lines and connections in Illinois, and also prospective lines and connections in Missouri.

The attention of stockholders is called to the accompanying report of the Secretary and Treasurer, showing the several accounts of the company in detail.

In conclusion, the board desire to acknowledge the efficient manner in which the business of the company has been conducted by its officers, agents, and employees during the past year.

Condition and Prospects of the Union Pacific.

On accepting the presidency of the Union Pacific Railroad Company, Mr. Thomas A. Scott delivered the following address:

GENTLEMEN: In taking charge of this important public highway as its President, in obedience to the unanimous call of its shareholders and the action of your board, I beg leave to state that so far as my experience of over 30 years in railway life can be made useful to the board and this shareholders' interest, it shall be freely given, and I trust that the financial results may in the future be found satisfactory. As a condition precedent to accepting the position, I made the following requirements: First, that all unsettled contracts for the construction and equipment of the road should be adjusted and paid; second, that all the floating debt of the company should be provided for as it matures, by the actual sale of the assets on hand applicable to that purpose. Both of these conditions having been complied with, and a satisfactory balance in cash and assets remaining in the treasury to provide for the contingent wants, I accept the position, and will endeavor to give it such time and attention as may be needed, in connection with the board and officers, to insure a proper management of the affairs of the company.

In order that we may understand in a brief form the present condition of the company, I have made the following summary from the official records as presented to me by the heads of the departments: Earnings during 1870—January 1 to June 30, \$3,794,727.91; July 1 to December 31, \$3,830,549.20; total, \$7,625,277.11; expenses—January 1 to June 30, \$2,740,472.27; July 1 to December 31, 1,936,942.51; total, \$4,677,414.78, making the net earnings \$2,947,862.33. The interest upon the bonded debt, including the 10 per cent. in-

come bonds, but exclusive of the land grant bonds, was \$2,831,123, leaving a surplus of \$116,739.23.

The land department bonds bearing 7 per cent. interest in currency are \$10,000,000, and the annual interest \$700,000; land sales 292,900 acres; proceeds, \$1,306,566; average price per acre, \$4.46. On account of these sales the company has received and redeemed land grant bonds to the extent of \$736,000, and for the remainder the company holds land notes maturing in one, two and three years with accrued interest amounting to \$576,650, making \$1,312,650. The condition of the land department may therefore be stated thus: Bonds, \$10,400,000; one year's interest thereon, \$728,000; total, \$11,128,000; principal reduced by lands redeemed, \$736,000; land notes on hand, \$576,650, making \$1,312,650; showing an absolute reduction of \$584,650.

After providing an amount equal to the interest upon the entire debt in the land department of \$584,650, the company is entitled, under grants from the government to 12,080,000 acres of land, pre-empted before the passage of the act, from which, after deducting the total amount heretofore sold—292,983 acres—there remains on hand, as an asset, 11,787,117 acres, which, at an average value of \$2 per acre, being 20 per cent. below the minimum government price for adjoining lands owned by it, should yield the gross sum of \$23,524,334. So much, therefore, as may be required is to be applied to the payment and the redemption of land grant bonds and interest thereon, and the balance will go into the treasury, as received from time to time, for the benefit of the shareholders.

In looking over the data submitted to me, I find, as before stated, first, that the gross earnings for the past year show an aggregate of \$7,625,277; that the average expenses for the last year, during which the working organization was reduced to meet the existing wants for six months of the year, have been per month \$323,000, during which time the road has been thoroughly maintained and operated efficiently for that cost, being about 52 per cent. of the gross earnings.

It shall be the effort of the management to provide for and have a largely increased traffic, and keep the expenditures of the year within this limit. Satisfactory assurances have been received from Mr. Sickles, Chief Engineer and Superintendent of the line, that this can be effected. The arrangements recently perfected with steamship lines on the Pacific coast, and the steady growth of California in wealth and population, must result in a satisfactory increase of the through traffic. To this may be added a large increase of local traffic, caused by the rapid development of the rich mining districts of Utah, Colorado, Montana and other Territories, the traffic of which (supplies as well as productions) must, to a large degree, pass over our line.

From present indications, it would seem reasonable to estimate the gross receipts of the coming year at a minimum of \$9,000,000, with a cost of maintaining and operating the line on this increased earnings of not exceeding, say, \$4,500,000, leaving as the net receipts \$4,500,000, to be applied to the interest and dividends if so directed by the board, exclusive of the operations of the land department. The completion of the bridge across the Missouri River at Omaha within the present year, for which means have been provided by the sale of bridge bonds, as specially authorized by act of Congress, will greatly facilitate the movement of traffic, and relieve the public from the serious delay and hindrance incident to a transfer by ferry.

The operations of the line for the first twenty months of its existence as a completed road, show net earnings sufficient to meet the interest upon its entire bonded debt. This result cannot but be deemed by all practically versed in the history of new railway lines as indicating a successful future. The yearly increase of traffic, costing but little additional to transport, and therefore yielding a large percentage of net revenue, must soon give a value to your property not fully appreciated at present.

—A telegram from La Crosse, Wisconsin, dated the 15th inst., says that the navigation of the Upper Mississippi is being rapidly extended northward. The railroad winter bridges at Prairie du Chien, LaCrosse and Winona have been removed, and the river as far up as Lake Pepin will be navigable this week. The steamer Northwestern, of the Northwestern Union Packet Company, left Prairie du Chien at 10 o'clock this morning, and is expected at LaCrosse this evening, from St. Louis. The southern Minnesota Railroad ferry boat is running between La Crosse and the railroad station.

—There was a report this week that the Upper Mississippi packet lines would run in competition this season, and that no regular rates would be maintained; but this report has been contradicted, and it is now asserted that the combinations of last summer will be continued.

—The Peninsular & Oriental (British) Steamship Company, running on the Suez route, have reduced their fares for cabin and steerage from Liverpool, thus:

	Old Prices.		New Prices.	
	Cabin.	Steerage.	Cabin.	Steerage.
To Calcutta.....	\$475	\$275	\$350	\$225
Hong Kong.....	600	325	450	275
Shanghai.....	650	375	500	300
Yokohama.....	750	425	600	350
Sydney.....	900	375	425	250

The reductions in the cabin range from \$125 to \$250, and in the steerage from \$50 to \$125. The prices on Messageries Imperiales, the French Suez line, were about the same as by the Peninsular & Oriental steamers, but will probably be reduced, for without reduction the line would have no patronage. By the American line, the fare is, from Liverpool to Yokohama, \$448 in the cabin, and \$169 in the steerage, and to Hong Kong \$398 and \$184 respectively.

PUBLISHERS' ANNOUNCEMENTS.

The reader will find in our advertising columns an advertisement of the safe car lamps manufactured in Boston by Williams, Page & Co. These lamps, it is alleged, are absolutely safe, while they give a strong and clear light. The dangerous qualities of kerosene make it especially objectionable for use in cars, and the dim glimmer of the candles commonly used has little to recommend it except its cleanliness. An improvement is needed, and the article manufactured by Williams, Page & Co. deserves examination. It is highly recommended by those who have tested it.

WANTS.

A CIVIL ENGINEER of long experience desires an engagement, either field or office work. Address Z. CLINTON, Railroad Gazette Office.

A CIVIL ENGINEER of over 16 years constant practice, and who is experienced in the Survey and Construction of Railroads is open to an engagement as Assistant Engineer on Railroad Works. For further information, apply to the Editor of the RAILROAD GAZETTE.

TO WHOM IT MAY CONCERN.—A Civil Engineer and Surveyor, of great practical experience is about to proceed to a new location, where a considerable business may be established. He would be glad to become associated with one in the possession of means, or a capitalist who would join him in the undertaking—none but of unexceptionable character entertained. Address W. B. S., Nevada Hotel, City.

AN ENGINEER experienced in railroad location and construction will be open to an engagement about the 1st of April (or perhaps sooner) as Principal Assistant or Chief, both of which positions he has occupied. For further information apply to the Editor of this paper.

A CIVIL ENGINEER wants an engagement—Railroad construction preferred.—P. O. Box 1165, Rockford, Ill.

A CIVIL ENGINEER who is thoroughly educated in his profession, has had experience in field work for several years, and is especially familiar with levelling and transit surveying, desires an engagement. Address TRANSIT, at the office of the RAILROAD GAZETTE.

AN ENGINEER, who has had nearly three years' experience in the use of the instruments, in railroad location and construction, wants a situation as assistant, either in Railroad or Mining Engineering. Address ASSISTANT, Gazette Office.

WANTED Every Railway Traveler in the United States and the Dominion of Canada wants every railway company to use the Thomas Safety Baggage Check. It is in use on over sixty of the best managed roads in the country and has been during the past three years, and not one piece of baggage to which this check has been attached has been lost or misappropriated. Every railroad man upon whose road it is in use says: "We are fully satisfied after a thorough trial and practical use of the Thomas Safety Baggage Check that it is the best and most reliable baggage check ever issued. It is cheaper, more satisfactory and better adapted to the business than any other check in use." All information in reference to the Thomas Safety Baggage Check will be given by addressing G. F. THOMAS, editor Appleton's Railway Guide, 91, 93 and 94 Grand Street, New York.

NOTICE TO CONTRACTORS.

HASTINGS & DAKOTA RAILWAY,
CHIEF ENGINEER'S OFFICE,
MINNEAPOLIS, MINN., March 8th, 1871.

Sealed proposals will be received at the office of the undersigned in Minneapolis until 6 o'clock P. M., on the 11th day of April, 1871, for the Grading, Masonry and Bridging, (except the Bridge across the Minnesota River at Chaska,) on twenty miles of the Hastings & Dakota Railway, commencing at the present end of the track in Scott County, and ending at or near the village of Carver.

Bids must be made separately for the Grading, Masonry and Bridging.

Bids for Grading may be made by sections or for the whole twenty miles.

Right reserved by the Company to reject any or all bids.

Profiles and specifications to be seen at the office of the undersigned in Minneapolis.

Award of contracts to be made at the office of the Company in Hastings, Minn., on the 12th day of April, 1871.

A. B. ROGERS,

Chief Engineer Hastings & Dakota Railway.

CHIEF ENGINEER'S OFFICE,
CHESAPEAKE & OHIO RAILROAD,
RICHMOND, VA., March 11, 1871.

NOTICE TO CONTRACTORS.—Sealed proposals will be received by the undersigned, at Richmond, Va., until 12 M., March 30th, 1871, for the construction of SHOPS at Huntington, W. Va., on the line of the Chesapeake & Ohio Railroad, near the Ohio River. Proposals will be made for the wood, iron, stone and brick work, and for the sewerage, plumbing, windows and door, separately. Plans and specifications can be seen at the offices of the company in Richmond and Huntington on and after the 20th instant.

H. D. WHITCOMB,
Chief Engineer.

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Fifty Tons Scrap Steel.
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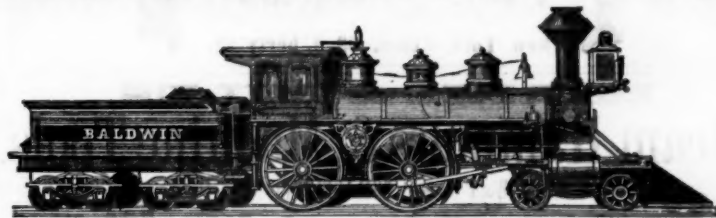
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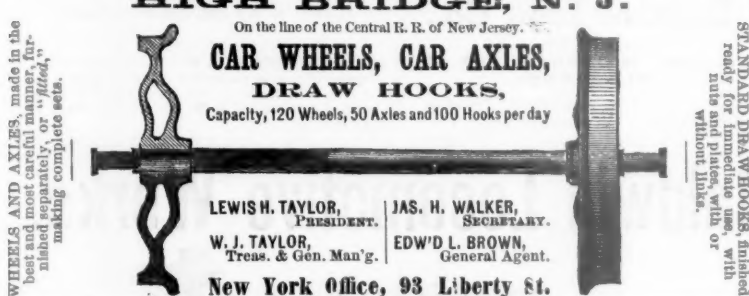


Unless the top and bottom tracks or guides for the rollers of sliding doors are adjusted with great accuracy, the doors will be held either too tight, and be unmovable, or else there will be "lost motion" between the rollers and the track, which will allow them to shake, and thus keep up a continual clatter. To obviate the difficulty and overcome these annoyances, the top rail is held down with spiral springs so that it will always fit accurately to the upper rollers without the possibility of there being either lost motion or of the doors "binding" on the track. The yielding and unstable character of the material of which doors are usually made makes some adjustability of the track necessary, in order to have them work easily. The cut, we think, will show clearly the manner in which this is accomplished. The top rail is attached to studs, which are held by brackets fastened to the door-frame. These studs have spiral springs which bear against the bracket at the top, and on shoulders on the studs at the bottom, and in this way press the rail down on the top rollers. If the door should shrink, the top rail will follow the contraction; or if anything should be placed on the bottom track the springs will allow the door to rise enough so that the lower rollers of the door can pass over any moderate obstruction. The arrangement is admirably adapted for car doors, and is already extensively used on the doors of Wagner's drawing room and other cars.

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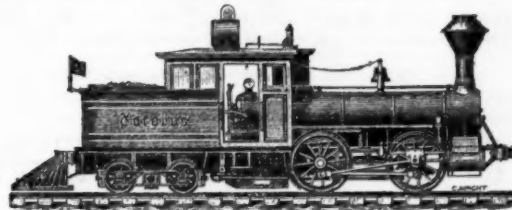
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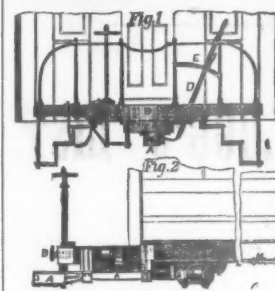
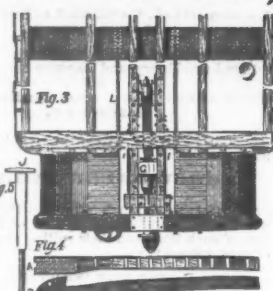
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COMPRESSION
BUFFERS— AND —
AUTOMATIC
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Railroad Cars.

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The advantages gained by the use of these improvements may be briefly stated as follows:

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- 2d. The platforms cannot be broken by any or-
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- 4th. Any required compression may be attained,
to prevent accidents by oscillation.
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is required to go between cars to couple them.
- 6th. The platforms may be held as close together
as desired.
- 7th. By close coupling the train is shortened.
- 8th. They will not accidentally uncouple.
- 9th. They may be uncoupled "without shutting
off," to make a flying switch.
- 10th. They are strong; the train will not "break
n two" at starting or while running.
- 11th. They cause the train to move steadily and
not jerk in starting or stopping.
- 12th. They work well at great variations of height.
- 13th. They will couple with all kinds of "draw-
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- 14th. They are cheap and durable.
- 15th. Injury to men when coupling cars is en-
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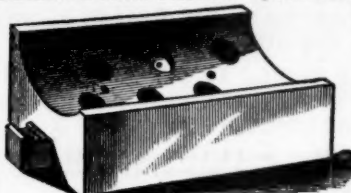
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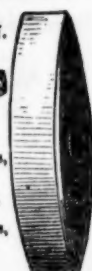
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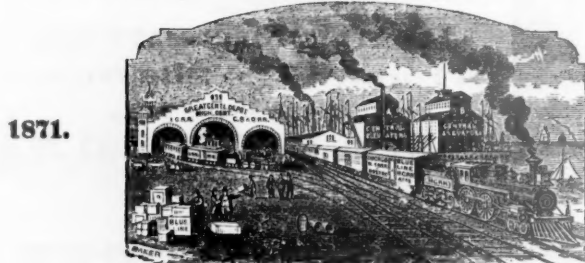
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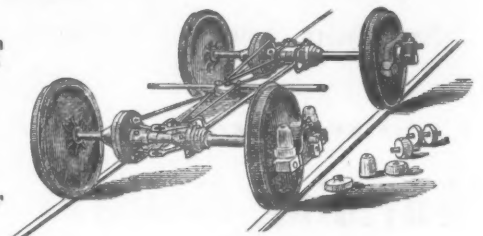
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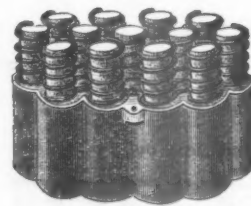
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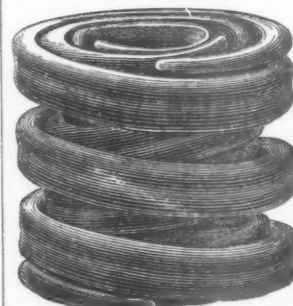
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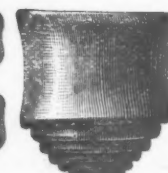
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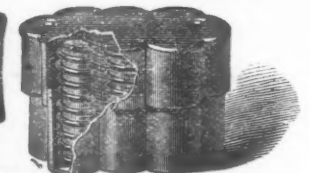
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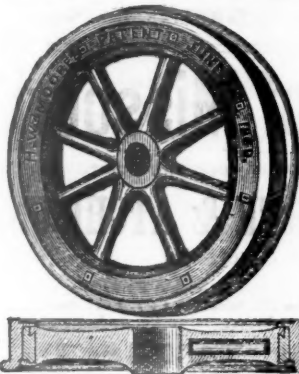
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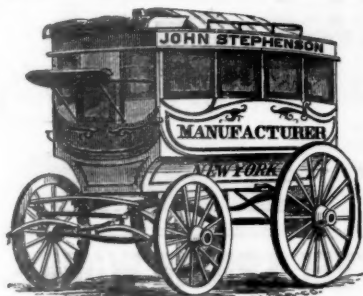
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BLISS, TILLOTSON & CO., Western Agents,
247 South Water Street, Chicago.

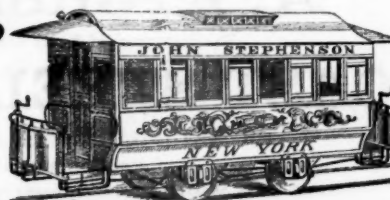


CARS,

LIGHT, STRONG

—AND—

ELEGANT!



OMNIBUSES

—OF—

EVERY STYLE!

Orders Promptly Filled.

CHICAGO, ROCK ISLAND & PACIFIC RAILROAD.

THE DIRECT ROUTE FOR
JOLIET, MORRIS, OTTAWA, LASALLE, PERU, HENRY, PEORIA,
Lacon, Geneseo, Moline,
ROCK ISLAND, DAVENPORT,
Muscatine, Washington, Iowa City,
GRINNELL, NEWTON, DES MOINES,

COUNCIL BLUFFS & OMAHA!

CONNECTING WITH TRAINS ON THE UNION PACIFIC RAILROAD, FOR

Cheyenne, Denver, Central City, Ogden, Salt Lake,
White Pine, Helena, Sacramento, San Francisco,

And Points in Upper and Lower California; and with Ocean Steamers at San Francisco, for all Points in
China, Japan, Sandwich Islands, Oregon and Alaska.

TRAINS LEAVE their Splendid new Depot, on VanBuren Street, Chicago, as follows:

	LEAVE.	ARRIVE.
PACIFIC EXPRESS, (Sunday excepted).....	10.00 a. m.	4.15 p. m.
PERU ACCOMMODATION, (Sundays excepted).....	4.30 p. m.	9.45 a. m.
PACIFIC EXPRESS, (Saturdays excepted,).....	10.00 p. m.	(Mon. ex. 7.00 a. m.)

ELEGANT PALACE SLEEPING COACHES!

Run Through to Peoria and Council Bluffs, Without Change.

Connections at LA SALLE, with Illinois Central Railroad, North and South; at PEORIA, with
Peoria, Pekin & Jacksonville Railroad, for Pekin, Virginia, &c.; at POET BYRON JUNCTION, for
Hampton, LeClaire, and Port Byron; at ROCK ISLAND, with Packets North and South on the Mis-
sissippi River.

For Through Tickets, and all desired information in regard to Rates, Routes, etc., call
at the Company's Offices, No. 37 South Clark Street, Chicago, or 257 Broadway, New York.

A. M. SMITH, Gen. Pass. Agent. HUGH RIDDLE, Gen. Supt. P. A. HALL, Asst. Gen. Supt.

KANSAS PACIFIC RAILWAY.

Great Smoky Hill Route

THROUGH KANSAS TO DENVER, COLORADO.

Connecting with the DENVER PACIFIC R. R. for CHEYENNE; forming, in connection with the
UNION and CENTRAL PACIFIC R. R.'s, a NEW ALL-RAIL ROUTE to

**Colorado, Wyoming, Utah, Montana,
NEVADA, CALIFORNIA,**
AND THE PACIFIC COAST.

THE ONLY ROUTE RUNNING PULLMAN DRAWING-ROOM & SLEEPING CARS THROUGH TO DENVER.

No Omnibus or Ferry Transfer!

Direct Connections made in UNION DEPOTS at Kansas City [State Line.] with the Hanni-
bal & St. Joseph, North Missouri and Missouri Pacific Railroads.

Daily Trains leave Kansas City, State Line and Leavenworth, for Lawrence, Topeka, Emporia,
Humboldt, New Chicago, Chetopa, Junction City, Abilene, Salina, Brookville, Ellsworth, Hays, KIT
CARSON, DENVER, GREELEY, CHEYENNE, OGDEN, SALT LAKE CITY, CORINNE.

Sacramento & San Francisco.

Connect at Kit Carson with Southern Overland Passenger and Mail Coaches for PUEBLO,
TRINIDAD, SANTA FE, and all principal points in

Old and New Mexico and Arizona.

Connect at DENVER with the Colorado Central Railroad and Fast Concord Coaches, for
Golden City, Black Hawk, Central City, Idaho City, Georgetown and Fair Play.

Passenger and Freight Rates as low and conveniences as ample as by any Route.

Ask for Tickets via **KANSAS PACIFIC RAILWAY**, which can be obtained at all
principal ticket offices in the United States.

BEVERLY R. KEIM, Gen. Ticket Agt. T. F. OAKES, Gen. Freight Agt. A. ANDERSON, Gen. Supt.
Lawrence, Kansas. Kansas City, Mo. Lawrence, Kan.

FARMS AND HOMES IN KANSAS.

Five Million Acres of Choice Farming Lands, situated along the line of this Great
National Route, at from one to six dollars per acre. For full particulars, apply to
JNO. P. DEVEREUX, Land Commissioner, Lawrence, Kan.

THE ERIE & PACIFIC DISPATCH CO.

Are Authorized Freight Agents.

For Information, Contracts, and Bills of Lading, apply at their office, 64 Clark Street, Chicago.

H. H. RAPP, AGT.

Western Union Railroad.

CHICAGO & NORTHWESTERN DEPOT, MILWAUKEE & CHICAGO DEPOT,
CHICAGO. MILWAUKEE.

THE DIRECT ROUTE!
CHICAGO, RACINE & MILWAUKEE,

TO
Beloit, Savanna, Clinton, Pt. Byron, Davenport, Mineral Point,
Madison, Freeport, Fulton, Lyons, Rock Island, Sabula,
Galena, Dubuque, Des Moines, Council Bluffs,

OMAHA, SAN FRANCISCO

AND ALL PRINCIPAL POINTS IN

Southern and Central Wisconsin, Northern Illinois, and Central and Northern Iowa.

FRED. WILD,
Gen. Ticket Agent.

D. A. OLIN,
Gen. Superintendent.

THE FAVORITE THROUGH PASSENGER ROUTE!

Chicago, Burlington & Quincy RAILROAD LINE.

3 THROUGH EXPRESS TRAINS DAILY!

FROM CHICAGO	Hours.	1st Class Fare.	FROM CHICAGO	Days.	1st Class Fare.
TO OMAHA, - - -	23	\$20.00	TO DENVER, - - -	2½	\$63.00
" ST. JOSEPH, - - -	21	19.50	" SACRAMENTO, - - -	4½	118.00
" KANSAS CITY, - - -	22	20.00	" SAN FRANCISCO, - - -	5	118.00

TRAINS LEAVE CHICAGO from the Great Central Depot, foot of Lake Street, as follows:

BURLINGTON, KEOKUK, COUNCIL BLUFFS & OMAHA LINE

7:40 A. M. MAIL AND EXPRESS. (Except Sunday,) stopping at all stations; making close connections at Mendota with Illinois Central for Amboy, Dixon, Freeport, Galena, Dunleith, Dubuque, LaSalle, El Paso, Bloomington, &c.

10:45 A. M. PACIFIC FAST LINE. (Except Sunday,) stopping at all stations; making close connections at Mendota with Illinois Central for Amboy, Dixon, Freeport, Galena, Dunleith, Dubuque, LaSalle, El Paso, Bloomington, &c.

ELEGANT DAY COACHES and PULLMAN PALACE DRAWING ROOM CARS are attached to this train daily from Chicago.

TO COUNCIL BLUFFS & OMAHA WITHOUT CHANGE!

9:00 P. M. PACIFIC NIGHT EXPRESS. (Daily, except Saturday,) for Burlington, Ottumwa, Des Moines, Nebraska City, Council Bluffs, Omaha, and all points West. Pullman Drawing Room Sleeping Car attached to this train daily from Chicago to Burlington, and Elegant Day Coaches, from Chicago to Council Bluffs and Omaha, without change! This is the Route between

CHICAGO, COUNCIL BLUFFS & OMAHA,

—RUNNING THE CELEBRATED—

Pullman Palace Dining Cars!

49 MILES THE SHORTEST ROUTE BETWEEN

Chicago & Keokuk,

And the Only Route Without Ferrying the Mississippi River!

QUINCY, ST. JOSEPH, LEAVENWORTH & KANSAS CITY LINE.

7:40 A. M. MAIL AND EXPRESS (Except Sunday,) stopping at all stations between Chicago and Galesburg; making close connections at Mendota with Illinois Central for Amboy, Dixon, Freeport, Dunleith, Dubuque, LaSalle, El Paso, Bloomington, &c.

10:45 A. M. PACIFIC EXPRESS. (Daily, except Sunday,) with ELEGANT DAY COACHES and PULLMAN'S PALACE SLEEPING CARS attached, running through from Chicago to KANSAS CITY, Without Change!

9:00 P. M. PACIFIC NIGHT EXPRESS. (Daily,) with Pullman Palace Drawing Room Sleeping Car attached running through from Chicago to QUINCY.

Kansas City, Lawrence, Topeka and Denver,

WITHOUT CHANGE!

64 MILES THE SHORTEST AND ONLY ROUTE BETWEEN

Chicago and Kansas City!

WITHOUT CHANGE OF CARS OR FERRY.

115 MILES The Shortest Route bet. Chicago & St. Joseph.

THE SHORTEST, BEST AND QUICKEST ROUTE BETWEEN CHICAGO AND

Atchison, Weston, Leavenworth, Lawrence,

AND ALL POINTS ON THE KANSAS PACIFIC R.Y.

Local Trains Leave

RIVERSIDE & HINSDALE ACCOMMODATION, 7:00 A. M. 1:30 & 6:15 P. M.	
GALESBURG PASSENGER, 3:00 P. M.	
MENDOTA PASSENGER, 4:15 P. M.	
AURORA PASSENGER, 5:30 P. M.	

Ask for Tickets via Chicago, Burlington & Quincy Railroad, which can be obtained at all principal offices of connecting roads, at Company's office, 63 Clark Street, and at Great Central Depot, Chicago at as low rates as by any other route.

ROB'T HARRIS, Gen'l Superintendent, CHICAGO. **SAM'L POWELL,** Gen'l Ticket Agent, CHICAGO. **E. A. PARKER,** Gen. West. Pass. Agt., CHICAGO.

THE GREAT THROUGH PASSENGER ROUTE TO KANSAS

IS VIA THE OLD RELIABLE

HANNIBAL & ST. JOSEPH SHORT LINE.

Crossing the Mississippi at Quincy and the Missouri at Kansas City on New Iron Bridges; running Three Daily Express Trains, Through Cars and Pullman Sleeping Palaces from Chicago & Quincy to St. Joseph & Kansas City.

The Advantages gained by this Line over any other Route from Chicago, are:

115 MILES THE SHORTEST!

To St. Joseph, Atchison, Hiawatha, Waterville, Weston, Leavenworth,

64 MILES THE SHORTEST!

To Kansas City, Fort Scott, Lawrence, Ottawa,

Garnett, Iola, Humboldt, Topeka, Burlingame, Emporia, Manhattan, Fort Riley, Junction City, Salina, Ellsworth, Hays, Sheridan, Olathe, Paola, Cherokee Neutral Lands, Baxter Springs, Santa Fe, New Mexico, and all Points on the KANSAS PACIFIC, and MISSOURI RIVER, FT. SCOTT & GULF R.R.'s, with which we connect at Kansas City Union Depot.

THIS BEING THE SHORTEST LINE AND QUICKEST, is consequently the cheapest; and no one that is posted thinks of taking any other Route from Chicago to reach principal points in

Missouri, Kansas, Indian Territory, or New Mexico.

DAILY OVERLAND STAGES from west end Kansas Pacific Railway, for Pueblo, Santa Fe, Denver, and points in Colorado and New Mexico.

This is also a most desirable Route, via St. Joseph, to Brownsville, Nebraska City, Council Bluffs, and Omaha, connecting with the Union Pacific Railroad for Cheyenne, Denver, Salt Lake, Sacramento, San Francisco, and the Pacific coast.

Through Tickets for Sale at all Ticket Offices. Baggage Checked Through, and Omnibus Transfers and Portage avoided.

P. B. GROAT, Gen. Ticket Agent.
HANNIBAL, Mo.

GEO. H. NETTLETON, Gen. Supt.
HANNIBAL, Mo.

Old, Reliable, Air-Line Route!

CHICAGO, ALTON & ST. LOUIS R. R.

SHORTEST, QUICKEST AND ONLY DIRECT ROAD TO

Bloomington, Springfield, Jacksonville, Alton,

—AND—

ST. LOUIS!

WITHOUT CHANGE OF CARS.

THE ONLY ROAD MAKING IMMEDIATE CONNECTIONS AT ST. LOUIS WITH MORNING AND EVENING TRAINS

—FOR—

ATCHISON, LEAVENWORTH, KANSAS CITY,

Lawrence, Topeka, Memphis, New Orleans,

And All Points South and Southwest.

TRAINS leave CHICAGO from the West-side Union Depot, near Madison Street Bridge.

	Depart.	Arrive.
EXPRESS MAIL	*9:15 A. M.	*8:05 P. M.
JOLIET ACCOMMODATION	*4:00 P. M.	*9:40 A. M.
NIGHT EXPRESS	*1:30 "	*12:50 P. M.
LIGHTNING EXPRESS	*9:00 "	*7:30 A. M.

*Sundays excepted.

†Daily; Saturdays it runs to Bloomington only.

‡Saturdays and Sundays excepted. Monday mornings this train runs from Bloomington to St. Louis.

This is the ONLY LINE Between CHICAGO & ST. LOUIS RUNNING

Pullman's Palace Sleeping and Celebrated Dining Cars!

BAGGAGE CHECKED THROUGH.

Through Tickets can be had at the Company's office, No. 55 Dearborn street, Chicago, or at the Depot, corner of West Madison and Canal streets, and at all principal Ticket Offices in the United States and Canada. Rates of Fare and Freight as low as by any other Route.

A. NEWMAN, Gen. Pass. Agent.**J. C. McMULLIN,** Gen. Supt.

Pacific Railroad of Missouri.

THE MOST DIRECT AND RELIABLE ROUTE FROM ST. LOUIS THROUGH TO

KANSAS CITY, LEAVENWORTH & ATCHISON,

WITHOUT CHANGE OF CARS!

Close Connections at KANSAS CITY with Missouri Valley, Missouri River, Ft. Scott & Gulf, and Kansas Pacific R'y's, for Weston, St. Joseph, Junction City, Fort Scott, Lawrence, Topeka, Sheridan, Denver, Fort Union, Santa Fe, and

ALL POINTS WEST!

At SEDALIA, WARRENSBURG and PLEASANT HILL, with Stage Lines for Warsaw, Quincy, Bolivar, Springfield, Clinton, Osceola, Lamar, Carthage, Granby, Neosho, Baxter Springs, Fort Gibson, Fort Smith, Van Buren, Fayetteville, Bentonville.

PALACE SLEEPING CARS on all NIGHT TRAINS.

Baggage Checked Through Free!

THROUGH TICKETS for sale at all the Principal Railroad Offices in the United States and Canada. Be Sure and Get your Tickets over the PACIFIC R. R. OF MISSOURI.

W. B. HALE,
Gen. Pass. and Ticket Agt.

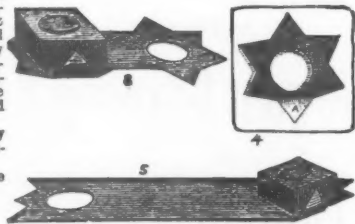
THOS. MCKISSOCK,
General Superintendent.

THE UNION PATENT STOP WASHER,

Manufactured at Coatesville, Chester Co., Pa., on the line of the Pennsylvania Central R. R., has now stood the test of practical use on the above road, the Philadelphia, Wilmington & Baltimore and Philadelphia & Reading Railroads, for the past two years, and proved itself to be what is claimed for it—a perfect security against the unscrewing or receding of nuts. Its simplicity, efficiency and cheapness over any other appliance for the purpose should recommend it to the attention of all persons having charge of Railroad tracks, cars and machinery.

It is especially adapted to, and extensively used by leading Railroads of the country for the purpose of securing nuts on railway joints.

The accompanying cuts show the application of the Washer. For further information, apply to

A. GIBBONS, Coatesville, Pa.

PITTSBURGH CAST STEEL SPRING WORKS.

A. French & Co.,

Manufacturers of Extra Tempered, Light Elliptic

CAST STEEL SPRINGS,

FOR RAILROAD CARS AND LOCOMOTIVES,

FROM BEST CAST STEEL.

OFFICE AND WORKS:—Cor. Liberty and 21st Sts., PITTSBURGH, PA.

ST. LOUIS BRANCH, M. M. BUCK & CO.

CHICAGO BRANCH, 88 Michigan Ave.

ILLINOIS CENTRAL RAILROAD.

PASSENGER TRAINS LEAVE CHICAGO FROM THE GREAT CENTRAL DEPOT, FOOT OF LAKE ST.

ST. LOUIS AND CHICAGO THROUGH LINE.

No Change of Cars from Chicago to St. Louis.

9:20 A. M. DAY EXPRESS Sundays Ex. Arriving in ST. LOUIS at 10:30 P. M.

8:15 P. M. FAST LINE. Saturdays Excepted. Arriving at ST. LOUIS at 8:00 A. M.

AT ST. LOUIS, Direct Connections are Made FOR

Jefferson City, Sedalia, Pleasant Hill, Macon, Kansas City,

LEAVENWORTH, ST. JOSEPH & ATCHISON,

—Connecting at KANSAS CITY for—

LAWRENCE, TOPEKA, JUNCTION CITY, SALINA, SHERIDAN,

Denver and San Francisco!

CAIRO, MEMPHIS AND NEW ORLEANS LINE.

No Change of Cars from Chicago to Cairo.

9:20 A. M. CAIRO MAIL, Sundays Excepted. Arriving at Cairo 2:05 A. M., Memphis 12:45 P. M., Mobile 9:25 A. M. Vicksburg 9:35 A. M., New Orleans 11:05 A. M.

8:15 P. M. CAIRO EXPRESS, Except Saturdays. Arriving at Cairo 12:34 P. M., Memphis 4:15 A. M., Little Rock 7:00 P. M., Vicksburg 8:10 P. M., New Orleans 1:30 A. M.

4:50 P. M. CHAMPAIGN PASSENGER, Arriving at Champaign at 10:45 P. M.

THIS IS THE ONLY DIRECT ROUTE TO

Humboldt, Corinth, Grand Junction, Little Rock, Hot Springs, Selma, Canton, Grenada, Columbus, Meridian, Enterprise,

MEMPHIS, VICKSBURG, NEW ORLEANS & MOBILE.

At NEW ORLEANS, connections are made for

GALVESTON, INDIANOLA,

And all Parts of Texas.

NOTICE.—This Route is from 100 to 150 MILES SHORTER, and from 12 to 24 HOURS QUICKER than any other.

THIS IS ALSO THE ONLY DIRECT ROUTE TO

DECATUR, TERRE HAUTE, VINCENNES & EVANSVILLE.

Peoria and Keokuk Line.

9:20 A. M. KEOKUK PASSENGER, Sun. Excepted. Arriving at Chenoa 3:30 P. M., El Paso 4:08 P. M., Peoria 5:43 P. M., Canton 7:15 P. M., Bushnell 8:57 P. M., Keokuk 11:15 P. M., Warsaw 11:40 A. M.

Elegant Drawing Room Sleeping Cars

ATTACHED TO ALL NIGHT TRAINS.

Spacious and Fine Saloon Cars!

WITH ALL MODERN IMPROVEMENTS, RUN UPON ALL TRAINS.

BAGGAGE CHECKED THROUGH TO ALL IMPORTANT POINTS.

For Through Tickets, Sleeping Car Berths, Baggage Checks, and information, apply at the office of the Company in the Great Central Depot, foot of Lake St.

Hyde Park and Oakwoods Train.

HYDE PARK TRAIN...	LEAVE 6:30 A. M.	ARRIVE 7:45 A. M.	HYDE PARK TRAIN...	LEAVE 7:30 P. M.	ARRIVE 7:15 P. M.
HYDE PARK TRAIN...	6:30 A. M.	7:30 A. M.	HYDE PARK TRAIN...	7:30 P. M.	7:35 P. M.
HYDE PARK TRAIN...	7:10 P. M.	1:45 P. M.			

* Sundays Excepted.

W. P. JOHNSON, Gen. Pass. Agen

CHICAGO & NORTHWESTERN R. W.

Comprising the PRINCIPAL RAILROADS from CHICAGO Directly NORTH NORTH-WEST and WEST.

ALL RAIL TO THE PACIFIC OCEAN!

Great California Line.

TRAINS LEAVE WELLS STREET DEPOT AS FOLLOWS:

8:30 A. M. Clinton Passenger.	10:00 P. M. Night Mail.
10:45 A. M. Pacific Express.	10:00 P. M. Rock Island Pass.
10:45 A. M. Rock Island Exp.	4:00 P. M. Dixon Passenger.

For Sterling, Rock Island, Fulton, Clinton, Cedar Rapids, Boone, Denison, Missouri Valley Junction, Sioux City, Council Bluffs and Omaha, there connecting with the

UNION PACIFIC R. R.

For Cheyenne, Denver, Ogden, Salt Lake, the White Pine Silver Mines, Sacramento, San Francisco, and all parts of Nebraska, Colorado, New Mexico, Arizona, Wyoming, Montana, Idaho, Utah, Nevada, and the PACIFIC COAST.

FROM CHICAGO	Hours	1st Class Fare.	FROM CHICAGO	Days	1st Class Fare.
To OMAHA.....	23	\$20.00	To SACRAMENTO..	4 1/2	\$118.00
" DENVER.....	52	65.00	" SAN FRANCISCO, 5		118.00

TRAINS ARRIVE:—Night Mail, 7:15 a. m.; Dixon Passenger, 11:10 a. m.; Pacific Express 4:15 p. m.; Rock Island Express, 4:15 p. m.; Clinton Passenger, 6:45 p. m.

FREEPORT LINE.

9.00 A. M. & 9.00 P. M. For Belvidere, Rockford, Freeport, Galena, Dunleith, and St. Paul.

4.00 P. M. Rockford Accommodation.
5.30 P. M. Geneva and Elgin Accommodation.
6.10 P. M. Lombard Accommodation.
5.50 P. M. Junction Passenger.

TRAINS ARRIVE:—Freeport Passenger, 2:30 p. m.; 6:40 a. m.; Rockford Accommodation 11:10 a. m.; Geneva and Elgin Accommodation, 8:45 a. m.; Junction Passenger, 8:10 a. m.; Lombard Accommodation, 6:50 a. m.

WISCONSIN DIVISION.

Trains leave Depot, cor. West Water and Kinzie Sts., daily, Sundays excepted, as follows:
10.00 A. M. DAY EXPRESS, for Janesville, Monroe, Whitewater, Madison, Prairie du Paul, and ALL POINTS ON THE UPPER MISSISSIPPI RIVER; Ripon, Berlin, Fond du Lac, Oshkosh, Neenah, Appleton, and Green Bay.

3.00 P. M. Janesville Accommodation.
5.00 P. M. NIGHT EXPRESS, for Madison, Prairie du Chien, Watertown, Minnesota Junction, Portage City, Sparta, La Crosse, St. Paul, and ALL POINTS ON THE UPPER MISSISSIPPI RIVER; Ripon, Berlin, Fond du Lac, Oshkosh, Menasha, Appleton, Green Bay, and THE LAKE SUPERIOR COUNTRY.

5.30 P. M. Woodstock Accommodation.
TRAINS ARRIVE:—7:00 a. m., 7:15 p. m., 9:00 a. m., and 2:05 p. m.

MILWAUKEE DIVISION.

MILWAUKEE MAIL, 8:15 A. M.
EXPRESS, (ex. Sun.) Waukegan, Kenosha, Racine and Milwaukee, 9:45 A. M.
EVANSTON ACCOMMODATION, 1:00 P. M.
HIGHLAND PARK PASSENGER, 6:20 P. M.
MILWAUKEE ACCOMMODATION, with Sleeping Car attached, 11:00 P. M.
KENOSHA ACCOMMODATION, (Sundays excepted) from Wells St. Depot, 4:10 P. M.
AFTERNOON PASSENGER, 5:00 P. M.
WAUKEGAN ACCOMMODATION, (except Sundays) from Wells St. Depot, 5:30 P. M.
TRAINS ARRIVE:—Night Accommodation, with Sleeping Car, 5:00 a. m.; Day Express, 4:15 p. m.; Milwaukee Mail, 10:30 a. m.; Afternoon Passenger, 7:40 p. m.; Waukegan Accommodation, 8:25 a. m.; Kenosha Accommodation, 9:10 a. m.; Evanston Accommodation, 3:30 p. m.; Highland Park Passenger, 7:55 p. m.

PULLMAN PALACE CARS ON ALL NIGHT TRAINS.

THROUGH TICKETS Can be purchased at all principal Railroad Offices East and South, and in Chicago at the Southeast corner of Lake and Clark Streets, and at the Passenger Stations as above.

H. P. STANWOOD,
Gen. Ticket Agt.

JOHN C. GAULT,
Gen'l Supt.

Milwaukee & St. Paul R. W.

THE ONLY ALL RAIL LINE TO

ST. PAUL AND MINNEAPOLIS!

AND ALL PORTIONS OF

Wisconsin, Minnesota & Northern Iowa.

PURCHASE TICKETS VIA MILWAUKEE.

Passengers Going via Milwaukee,

Have Choice of Seats in Clean Coaches, and on Night Trains, a full night's rest in Palace Sleeping Cars.

BAGGAGE CHECKED THROUGH BY THIS ROUTE ONLY!

PASSENGERS FROM CHICAGO can obtain these Advantages only by the MILWAUKEE DIVISION of the CHICAGO & NORTHWESTERN R. W.

SPECIAL NOTICE.—Passengers destined to any place in Wisconsin, Minnesota, or Northern Iowa, either on or off the Lines of this Company, who cannot procure Through Tickets to their destination, should purchase their Tickets TO MILWAUKEE, as this is the Great Distributing Point for these States.

A. V. H. CARPENTER,
Gen. Pass. Agt. Milwaukee.

S. S. MERRILL,
Gen. Manager, Milwaukee

61 Miles the Shortest Line!

— FROM —

CHICAGO TO NEW YORK.

Pitts., Ft. Wayne & Chicago

— AND —

PENNSYLVANIA CENTRAL

IS THE ONLY ROUTE

Running its Entire Trains THROUGH to Philadelphia and New York, and the only Route running Three Daily Lines of Pullman Day and Sleeping Palaces, from Chicago to

PITTSBURGH, HARRISBURG, PHILADELPHIA & NEW YORK,

WITHOUT CHANGE!

WITH BUT ONE CHANGE TO

BALTIMORE, PROVIDENCE, NEW HAVEN, HARTFORD, SPRINGFIELD, WORCESTER & BOSTON!

AND THE MOST DIRECT ROUTE TO WASHINGTON.

Trains Leave WEST SIDE UNION DEPOT, corner West Madison and Canal Streets, as follows:

	Mail.	Fast Express.	Pacific Exp.	Night Exp.
Leave—CHICAGO.....	5.30 A. M.	9.00 A. M.	5.15 P. M.	9.00 P. M.
Arrive—PLYMOUTH.....	9.50 "	12.08 P. M.	8.45 "	12.35 A. M.
" FORT WAYNE.....	12.30 P. M.	2.05 "	11.15 "	3.10 "
" LIMA.....	3.24 "	4.08 "	1.23 A. M.	5.40 "
" FOREST.....	4.48 "	5.08 "	3.45 "	7.07 "
Leave—CRESTLINE.....	6.30 "	6.30 "	4.30 "	8.55 "
Arrive—CRESTLINE.....	6.00 A. M.	6.50 "	4.30 "	9.35 "
" MANSFIELD.....	6.40 "	7.17 "	5.00 "	10.05 "
" ORRVILLE.....	9.15 "	9.05 "	6.54 "	11.55 "
" ALLIANCE.....	11.10 "	10.40 "	8.30 "	1.30 P. M.
" PITTSBURGH.....	11.57 "	1.55 A. M.	12.10 P. M.	4.40 "
" CRESSON.....	11.57 "	5.44 "	4.43 "	10.00 "
" ALTOONA.....	12.48 A. M.	6.55 "	5.55 "	2.40 A. M.
" HARRISBURG.....	5.30 "	11.25 "	10.45 "	9.50 "
" PHILADELPHIA.....	6.50 "	3.15 "	3.00 "	6.50 "
" NEW YORK, VIA PHILADELPHIA.....	10.30 "	6.30 "	6.41 "	10.30 "
" NEW YORK, VIA ALLENTOWN.....	10.30 "	6.30 "	6.41 "	10.30 "
" BALTIMORE.....	9.15 P. M.	3.05 "	2.30 A. M.	9.15 P. M.
" WASHINGTON.....	1.00 "	5.15 "	5.45 "	1.00 "
" BOSTON.....	9.00 "	5.50 A. M.	6.00 "	9.00 "

Boston and New England Passengers will find this Route especially Desirable, as it gives them an opportunity of Seeing the FINEST VIEWS AMONG THE ALLEGHANY MOUNTAINS,

Besides Visiting PITTSBURGH, PHILADELPHIA and NEW YORK, without extra cost!

All New England Passengers holding Through Tickets will be Transferred, with their Baggage, to Rail and Boat Connections in NEW YORK, Without Charge!

THROUGH TICKETS for sale at the Company's Offices, at 65 Clark St.; 52 Clark St.; cor. Randolph and LaSalle Sts.; and at Depot, Chicago. Also at Principal Ticket Offices in the West.

CLOSE CONNECTIONS Made at LIMA for all Points on the Dayton & Michigan and the Cincinnati, Hamilton & Dayton Railways, and at CRESTLINE for Cleveland and Columbus.

Express Trains are Equipped with WESTINGHOUSE AIR BRAKES,

The Most Perfect Protection Against Accidents in the World!

F. R. MYERS, Gen. Pass. & Tkt. Agt. P. F. W. & C. R'y Chicago. | Gen. Western Pass. Agt. P. F. W. & C. R'y, Chicago.
T. L. KIMBALL, Gen. Western Pass. Agt. Penn. Cen. R. R. Chicago.

Broad Gauge! Double Track!

ERIE RAILWAY.

4 EXPRESS TRAINS DAILY!
 From Cleveland, Dunkirk and Buffalo, 625 Miles, to New York, WITHOUT CHANGE of Coaches!

The Trains of this Railway are run in DIRECT CONNECTION WITH ALL WESTERN AND SOUTHERN LINES, for

Elmira, Williamsport, Oswego, Great Bend, Scranton, Newburgh,

NEW YORK, ALBANY, BOSTON, PROVIDENCE,
AND PRINCIPAL NEW ENGLAND CITIES.

New and Improved DRAWING ROOM COACHES are attached to the DAY EXPRESS Running THROUGH TO NEW YORK.

SLEEPING COACHES, Combining all Modern Improvements, with perfect Ventilation and the peculiar arrangements for the comfort of Passengers incident to the BROAD GAUGE, accompany all night trains to New York.

CONNECTIONS CERTAIN! as Trains on this Railway will, when necessary, wait from one to two hours for Western trains.

All Trains of Saturday run directly Through to New York.

Ask for Tickets via Erie Railway, which can be procured at 66 Clark Street Chicago, and at all Principal Ticket offices in the West and Southwest.

L. D. RUCKER, General Superintendent, New York. | **A. J. DAY,** Western Passenger Agent, Chicago. | **WM. R. BARR,** Gen'l Passenger Agent, New York.

Pan-Handle

— AND —

Penn'a Central Route East!

SHORTEST AND QUICKEST ROUTE, VIA COLUMBUS, TO
 PITTSBURGH, BALTIMORE, PHILADELPHIA & NEW YORK

On and after Sunday, NOVEMBER 20th, 1870, Trains for the East will run as follows:

[DEPOT CORNER CANAL AND KINZIE STS., WEST SIDE.]

7:40 A. M. DAY EXPRESS.
 [SUNDAYS EXCEPTED.] Via Richmond. Arriving at

COLUMBUS... 8:00 A. M. | HARRISBURG... 10:35 P. M. | NEW YORK... 6:40 A. M. | WASHINGTON... 5:45 A. M.
 PITTSBURGH... 12:15 P. M. | PHILADELPHIA 3:10 A. M. | BALTIMORE... 2:30 A. M. | BOSTON... 5:05 P. M.

7:10 P. M. NIGHT EXPRESS.
 [SUNDAYS EXCEPTED.] Arriving at:

COLUMBUS... 11:15 A. M. | HARRISBURG... 5:30 A. M. | NEW YORK... 11:40 A. M. | WASHINGTON... 1:10 P. M.
 PITTSBURGH... 7:35 P. M. | PHILADELPHIA 9:50 A. M. | BALTIMORE... 9:30 A. M. | BOSTON... 11:55 P. M.

Palace Day and Sleeping Cars

Run Through to COLUMBUS, and from Columbus to NEW YORK, WITHOUT CHANGE!

ONLY ONE CHANGE TO NEW YORK, PHILADELPHIA, OR BALTIMORE!

CINCINNATI & LOUISVILLE AIR LINE SOUTH.

35 Miles the Shortest Route to Cincinnati.

18 Miles the Shortest Route to Indianapolis and Louisville

3 Hours the Quickest Route to Cincinnati!

THE SHORTEST AND BEST ROUTE TO

Columbus, Chillicothe, Hamilton, Wheeling, Parkersburg, Evansville,
 Dayton, Zanesville, Marietta, Lexington, Terre Haute, Nashville,

ALL POINTS IN CENTRAL & SOUTHERN OHIO, & INDIANA, KENTUCKY & VIRGINIA.

— QUICK, DIRECT AND ONLY ALL RAIL ROUTE TO —

New Orleans, Memphis, Mobile, Vicksburg, Charleston, Savannah,
 AND ALL POINTS SOUTH.

Cincinnati, Indianapolis and Louisville Trains run as follows:

THROUGH WITHOUT CHANGE OF CARS!

7.40 A. M.	8.05 P. M.
(Sundays excepted.) Arriving at	(Saturdays excepted.) Arriving at
LOGANSPORT..... 1:15 P. M.	LOGANSPORT..... 1:15 A. M.
KOKOMO..... 2:33 P. M.	KOKOMO..... 2:31 A. M.
CINCINNATI..... 10:10 P. M.	CINCINNATI..... 2:35 A. M.
INDIANAPOLIS..... 5:00 P. M.	INDIANAPOLIS..... 5:40 A. M.
LOUISVILLE..... 11:30 P. M.	LOUISVILLE..... 3:50 P. M.

Lansing Accommodation: Leaves 3:40 P. M. Arrives 10:55 A. M.

PULLMAN'S PALACE SLEEPING CARS!

Accompany all Night Trains between Chicago and Cincinnati or Indianapolis.

Ask for Tickets via COLUMBUS for the East, and via "The AIR LINE" for Cincinnati, Indianapolis, Louisville and points South. Tickets for sale and Sleeping Car Berths secured at 95 RANDOLPH STREET, CHICAGO, and at Principal Ticket Offices in the West and Northwest.

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Northwestern Pass. Agt. Chicago

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The Great Favorite Route for Missouri, Nebraska and Iowa.

KANSAS CITY, ST. JOSEPH

— AND —

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THROUGH LINE!

8 EXPRESS PASSENGER TRAINS Leave Union Depot Daily, on the arrival of Eastern Southern and Western Trains, crossing the Missouri River on the New Iron Bridge at KANSAS CITY, passing the cities of

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CHEYENNE, DENVER, SALT LAKE, SACRAMENTO, SAN FRANCISCO
And the Pacific Coast.

Pullman's Palace Sleeping Cars!

ON ALL NIGHT TRAINS.

Ask for Tickets via the People's Favorite Route, Kansas City, St. Joseph & Council Bluffs Railroad Line.

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WITHOUT CHANGE!

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RUNNING PALACE COACHES THROUGH!
— BETWEEN —

CHICAGO & NEW YORK, via BUFFALO
WITHOUT TRANSFER OF PASSENGERS!

All Trains Stop at Twenty-Second Street to Take and Leave Passengers.
Baggage Checked at that Station for all Points East.

4 EXPRESS TRAINS DAILY, [Sundays Excepted,] Leave
Chicago from the New Depot, on Van Buren St., at the head of La Salle Street, as follow

5:30 A. M. MAIL TRAIN.
VIA OLD ROAD AND AIR LINE. SUNDAYS EXCEPTED.

Leaves 22d Street 7:45 A. M. Stops at all Stations. Arrives—Cleveland, 9:35 P. M.

9:00 A. M. SPECIAL NEW YORK EXPRESS,
VIA AIR LINE. SUNDAYS EXCEPTED.

Leaves—Twenty-Second Street, 9:15 A. M. Arrives—Elkhart, 12:45 P. M.; Cleveland 9:45 P. M.; Buffalo, 4:10 A. M.; New York, 7:00 P. M.; (Chicago Time) Boston, 11:45 P. M.

This Train has **PALACE SLEEPING COACH** Attached, Running
THROUGH TO ROCHESTER, WITHOUT CHANGE!

IN DIRECT CONNECTION WITH

Wagner's Celebrated Drawing-Room Coaches on N. Y. Central R. R.

Only Thirty-Three Hours, Chicago to New York!

5:15 P. M. ATLANTIC EXPRESS (Daily),
VIA OLD ROAD.

Leaves—Twenty-Second Street 5:30 P. M. Arrives—Laporte, 8:10 P. M. (Stops 20 minutes or Supper); arrives at Toledo, 3:50 A. M.; Cleveland, 7:25 A. M. (30 minutes for Breakfast); arrives at Buffalo, 1:50 P. M.; Rochester, 5:10 P. M. (30 minutes for Supper); connects with **Sleeping Coach** running Through from Rochester to Boston Without Change, making but One Change between Chicago and Boston.

NEW AND ELEGANT SLEEPING COACH Attached to this Train, Running
THROUGH from CHICAGO TO NEW YORK WITHOUT CHANGE! Arrives
at NEW YORK, 7:15 A. M.

9:00 P. M. NIGHT EXPRESS
VIA AIR LINE. (DAILY EXCEPT SAT. & SUN.)

Leaves—Twenty-Second Street, 9:15 P. M. Arrives—Toledo, 6:15 A. M. (30 minutes for Breakfast); arrives at Cleveland, 10:50 A. M.; Buffalo, 5:50 P. M.; New York, 12:00 M.; Boston, 3:50 P. M.

KALAMAZOO DIVISION.

Leave Chicago 9:00 A. M. Arrive at Kalamazoo 4:10 P. M.;
Grand Rapids, 7:10 P. M.

Leave Chicago 9:00 P. M. Arrive at Kalamazoo 7:25 A.
M.; Grand Rapids, 10:15 A. M.

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Travelers who wish to SAVE TIME and make SURE CONNECTIONS,
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AND ALL EASTERN POINTS.

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FROM CHICAGO TO NEW YORK WITHOUT CHANGE.

CELEBRATED HOTEL CARS FROM CHICAGO TO ROCHESTER.

Passenger Trains leave Chicago from Depot, foot of Lake Street, as follows: (All Trains
Stop at Twenty-Second Street Station to receive and leave Passengers.)

5:40 A. M. MAIL TRAIN, Sundays Excepted,
Has a car attached from Chicago going over both Main Line and Air Line
Division, Without Change. Connects at New Buffalo for St. Joseph; at Jackson
for Lansing, Saginaw and Bay City.

9:00 A. M. NEW YORK EXPRESS.
(SUNDAYS EXCEPTED.) Arrives at Michigan City at 11:10 A. M.; Niles,
12:30 P. M. (Dinner); Kalamazoo, 2:10 P. M.; Marshall, 3:24 P. M.; Jack-
son, 4:30 P. M.; Detroit, 6:55 P. M. (Supper); London, 11:25 A. M.; Hamilton, 3:35 A. M.; Niagara
Falls, 4: A. M.; Rochester, 7:10 A. M. (Breakfast); Albany, 2:00 P. M.; NEW YORK, 7:00 P. M.;
Springfield, 7:40 P. M.; BOSTON, 11:45 P. M. This Train connects at ROCHESTER with

Wagner's Drawing Room Car through to New York without change!

Connects at Kalamazoo direct for Grand Rapids, Muskegon, Whitehall, &c., &c.

9:30 A. M. CINCINNATI & LOUISVILLE EXPRESS
(SUNDAYS EXCEPTED.) Through Cars to Indianapolis and
Cincinnati without Change.

4:10 P. M. Kalamazoo, St. Joseph and Three Rivers Accom.
(SUNDAYS EXCEPTED.) Arrives at New Buffalo at 7:05 P. M.; St. Jo-
seph, 8:40 P. M.; Kalamazoo, 1:05 P. M.; Three Rivers, 10:00 P. M.

5:15 P. M. ATLANTIC EXPRESS.
Leaves Daily. Arrives at Michigan City at 7:15 P. M.; Niles, 8:30
P. M.; Jackson, 1:10 A. M.; Kalamazoo, 10:40 P. M.; Marshall, 1:10 A. M.; Jack-
son, 3:45 A. M.; London, 8:35 A. M. (Breakfast); Hamilton, 11:40 A. M.; Niagara Falls, 1:30 P. M.; Buf-
falo, 3:30 P. M.; Rochester, 5:10 P. M.; Albany, 1:30 A. M.; NEW YORK, 6:40 A. M.; Spring-
field, 6:40 A. M.; BOSTON 11:00 A. M. A MAGNIFICENT

PULLMAN DRAWING-ROOM SLEEPING CAR

IS ATTACHED TO THIS TRAIN DAILY, FROM

CHICAGO TO NEW YORK CITY.

The Celebrated **HOTEL CAR** is also Attached to this Train from
CHICAGO TO ROCHESTER.

SPECIAL NOTICE.—Boston and New England Passengers will please notice that this
Train now makes a direct connection through. A Sleeping Car is attached at Rochester at 5:30
P. M., running through to Springfield, Mass., thus avoiding transfer at Albany. Breakfast at Spring-
field. This Train reaches Springfield early enough second morning to CONNECT WITH ALL TRAINS
up and down the Connecticut

6:30 P. M. CINCINNATI & LOUISVILLE EXPRESS
(SATURDAYS EXCEPTED.) Through Sleeping Cars to Louis-
ville without Change.

This is the Only Line Running Sleeping Cars to Louisville!

9:00 P. M. NIGHT EXPRESS. Saturdays and Sundays Excepted
Arrives at Michigan City at 11:03 P. M.; Niles, 12:25 A. M.; Kalamazoo,
2:00; Marshall, 3:12; Jackson, 4:25; Grand Trunk Junction, 7:00; Detroit,
7:45; London, 1:45 P. M.; Hamilton, 4:35; Toronto, 9:35; Niagara Falls, 5:40; Buffalo, 7:15 P. M.;
Rochester, 9:10; Syracuse, 12:35 A. M.; Rome, 1:55; Utica, 2:25; Albany, 6:30 A. M.; NEW YORK,
12:00 M.; BOSTON, 3:30 P. M.

A PULLMAN PALACE SLEEPING CAR

Is attached to this Train for **DETROIT.** This Train connects at **DETROIT JUNCTION** with
Grand Trunk Railway for

MONTREAL, OGDENSBURG, &c.

9:00 P. M. Grand Rapids Express.
(SATURDAYS AND SUNDAYS EXCEPTED.) Arrives at Grand Rapids at
9:50 A. M.

An Elegant Pullman Sleeping Car

IS ATTACHED TO THIS TRAIN

THROUGH TO GRAND RAPIDS WITHOUT CHANGE!

Connecting there Direct to **MUSKEGON, WHITEHALL, &c., &c.,**

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have, during the past summer, put down 140 miles of New Rail, (a large proportion of the same being
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Through Tickets (and secured accommodations in Drawing-Room Sleeping Cars) can be
purchased in Chicago at 60 Clark street (under Sherman House); at 48 Clark street (Grand Trunk
Railway); at 53 Clark street (N. Y. C. R. R.); at office under Briggs House; at Great Central Depot,
and at

General Office in Tremont House Block.

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